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WIND SPEED, STABILITY CATEGORY, AND  
ATMOSPHERIC TURBULENCE AT SELECTED LOCATIONS

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May 1983



**U.S. ARMY MISSILE COMMAND**

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report includes climatological information about wind speed, atmospheric stability, and turbulent wind fluctuations. It contains frequency distributions of observed surface wind speeds at 35 stations located throughout the Northern Hemisphere. Observations from two German stations and one Korean station are classified as a function of wind speed and stability category. A procedure is developed to use these observations to prepare seasonal climatologies of turbulent wind fluctuations. Our data on Pasquill category and wind speed relationship are also compared with		

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four locations in the United states described in the literature. Finally, the United States data were also used to compute an annual climatology of turbulent wind fluctuations.

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## I. INTRODUCTION

This report contains climatological information about three atmospheric characteristics: mean wind speed, turbulent fluctuations of wind, and atmospheric stability. Wind speeds have been measured and recorded systematically at many locations throughout the world. The Richardson number, a stability parameter, can be computed from radiosonde data, but it is also possible to infer atmospheric stability from standard surface meteorological measurements by calculations of the Pasquill index. Surface data are readily available for numerous stations, but data for the calculation of the Richardson numbers are limited. When wind speed and stability are known, a good estimate of turbulent wind fluctuations, which are always present to some degree, can be made.

In order to extend the usefulness of this study, monthly frequency distributions of surface wind speeds at different locations in the Northern Hemisphere are included in the appendix.

Pasquill classes are widely used to estimate the degree of stability of the atmosphere from surface observations. The determination of these classes depends upon wind speed and heating or cooling by radiation. Heating during the day depends upon insolation which is a function of solar angle and amount and type of clouds. Cooling at night is estimated from cloud cover. The analysis in Section II shows that the atmosphere is unstable or neutral during the day and is stable or neutral after sundown. Neutral conditions are normally associated with the highest wind speeds at all hours.

Stewart (1981) reviewed and summarized earlier measurements of intensity of atmospheric turbulence in the planetary boundary layer. The magnitude of turbulent fluctuations varies in space and time. Turbulence is usually more intense over land than over water, and rough land surfaces cause more turbulence than smooth terrain. Intensity of turbulence is normally greater under unstable conditions than under stable conditions. The intensity of turbulence, which is the ratio of the standard deviation to the mean wind speed, tends to decrease as mean wind speed increases. Wind speed normally increases with altitude in the atmospheric boundary layer, and intensity of turbulence typically decreases rather rapidly with altitude in the lowest 20m. Decreases are slow above this level.

As pointed out, direct measurements of atmospheric turbulence are not available from any location for a long enough period to establish a climatology. Therefore, needed climatological information must be inferred from available meteorological data. The relationship between readily available meteorological data and turbulent wind fluctuations is described in Section III. The magnitude of turbulent fluctuations which are associated with a given wind speed depends upon atmospheric stability and is larger under unstable conditions. Section IV contains climatologies of turbulent wind fluctuations. These fluctuations are represented by  $\sigma_u$  which is the standard deviation of the longitudinal component of the wind. Most  $\sigma_u$ 's are less than 2 m/s except during the day in the summer.

## II. PASQUILL STABILITY CATEGORIES

When detailed measurements are available from special studies of turbulence, the most commonly used stability parameter is the Richardson number,  $Ri$ . This dimensionless number is usually defined by

$$Ri = \frac{g \frac{\partial \theta}{\partial z}}{\left(\frac{\partial u}{\partial z}\right)^2} \quad (1)$$

where  $g$  is the acceleration due to gravity,  $\theta$  is the potential temperature,  $z$  is the altitude, and  $\partial u / \partial z$  is the vertical wind shear. Richardson interpreted this as a characteristic ratio of work done against gravitational stability to energy transferred from mean to turbulent motion (Huschke, 1959). The atmosphere is gravitationally stable when the potential temperature increases with height and unstable when potential temperature decreases with height. Theoretical studies have indicated that the critical Richardson number is between 0.25 and 2 (Huschke, 1959), and Hansen (1977) believes that it is unity. However, some evidence supports the belief that the critical Richardson number is lower. Businger (1973) suggests 0.20-0.21, and Estoque (1973) even recommends the negative value -0.03. Values of  $Ri$  below the critical value are associated with instability, i.e., turbulence increases with time. Turbulence decreases with time for larger values of  $Ri$ , and the atmosphere is stable.

Pasquill (1961) outlined a procedure by which stability can be estimated from standard surface meteorological measurements. Six stability categories are specified in terms of wind speed, insolation, and state of the sky. Surface wind speeds are measured at the standard anemometer height of 10 m, and therefore these speeds give an indication of the wind shear in the lowest 10 m of the atmosphere, because it is assumed that the wind speed at ground level is zero. Insolation heats the surface, and surface heating causes steeper lapse rates to develop. If the insolation is large enough, the potential temperature may even decrease with altitude. Cooling of the surface at night causes a less steep lapse rate to develop, and a temperature inversion often forms. The amount of heating during the day and cooling at night depends upon the amount of cloud cover.

The six Pasquill categories are designated by the indices A through F. Categories A, B, and C are very unstable, moderately unstable, and slightly unstable, respectively. A neutrally stable atmosphere is indicated by D. Category E is moderately stable, and F is very stable.

Luna and Church (1972) processed standard surface weather observations to obtain Pasquill categories for 2461 cases. For each of these cases winds at 40 m and temperatures at 3 and 40 m were used to determine stability from a finite-difference form of the Richardson number which they called  $S$ . In their discussion Luna and Church implicitly assume that the critical Richardson number is zero, and that the neutral category of  $S$  should be centered at zero. Although the categories are established in the proper sequence, Luna and Church are concerned because approximately half the observations fall in the D (neutral) Pasquill category, but fewer than 6 percent of the computed  $S$  values are between -0.01 and +0.01. For practical

purposes, it seems reasonable to allow a wider range of S values to be in the neutral category. Furthermore, if Estoque's (1973) recommended critical Richardson number of -0.03 were used, a larger percent of S values would fall between -0.02 and -0.04. If a wider range is also assumed, it is realistic to conclude that between 20 and 30 percent of the S values fall in the neutral category. Luna and Church pointed out other small discrepancies which may be important in dealing with individual cases, but which should be much less serious when dealing statistically with large data collectives.

Pasquill stability indices in this report were determined according to the procedure outlined in Chapter 15 of Duncan (1981). Information from Duncan's Table 15-9 is listed here in Table 1, which contains the Pasquill index as a function of wind speed (V) and net radiative index (NRI). The net radiative index depends upon the mean cloud cover and height in the second layer and upon the solar angle. The solar angle ( $\alpha$ ) is a function of latitude, time of day, and time of year. Details of the computational method to obtain the solar angle can be obtained from a standard reference such as the Smithsonian Meteorological Tables (List, 1958).

When  $\alpha < 0$ , NRI depends upon the mean cloud cover (C) of the second layer according to the synoptic code and the mean cloud height (H) in hundreds of feet (1 ft = 0.3048 m). If C is 9 or 10, NRI = 5. When C = 8, NRI is 5 if  $H < 7$  and 6 if  $H > 7$ . For a C of 4-7, NRI = 6, and if C is 0-3, NRI = 7. Thus, at night NRI varies from 5 to 7.

When  $\alpha > 0$ , NRI depends upon C, H, and a parameter s which is a function of  $\alpha$ . Furthermore, when  $\alpha > 0$ , NRI cannot be greater than 4. If NRI is computed to be greater than 4 when  $\alpha > 0$ , it must be set equal to 4. The quantity  $s = 1$  for  $0 < \alpha < 15$ ,  $s = 2$  for  $15 < \alpha < 35$ ;  $s = 3$  for  $35 < \alpha < 60$ ; and  $s = 4$  for  $60 < \alpha < 90$ . When C = 0 through 4, NRI = 5-s. NRI = 4 for C = 9-10. For C = 5-7, NRI varies as follows: (1) if  $H < 7$ , NRI = 7-s; (2) if  $H = 7-16$ , NRI = 6-s; and (3) if  $H > 16$ , NRI = 5-s. When C = 8, NRI = 4 if  $H < 7$ . For C = 8, NRI = 7-s for  $H = 7-16$  and NRI = 6-s for  $H > 16$ .

Table 2 contains monthly summaries of the number of observations in various Pasquill categories as a function of wind speed at 0000 GMT in Frankfurt, West Germany. From the previous discussion it follows that only categories D, E, and F can occur at 0000 GMT at Frankfurt throughout the year. The very stable F category contains the largest number of observations throughout the year. In all months except November and December there are more observations classified as F than as D and E combined. Furthermore, wind speeds at Frankfurt are low near midnight. Annually, more than 70 percent of the wind speeds are less than 7 knots (3.6 m/s).

Observations of wind speed and Pasquill stability index at 0600 GMT at Frankfurt are shown in Table 3. Because the solar angle is negative in winter and positive in summer at this hour, all Pasquill indices had to be included in the table. In May, June, and July, the atmosphere at Frankfurt is moderately unstable at 0600 GMT more than one-third of the time, and in August more than one-fourth of the observations were made during moderately unstable conditions. During the months November through February the stability conditions at 0600 GMT are similar to those at 0000 GMT. Wind speeds are slightly higher during the early morning than near the middle of the night.

Data from Frankfurt at 1200 GMT are listed in Table 4. During the months November through February approximately one-third of the observations occurred under neutral stability, and fewer than one-third were moderately or very unstable. In June and July only a few percent were neutral, and more than 70 percent of the observations were at least moderately unstable. Wind speeds are higher in the middle of the day than at earlier hours throughout the year.

Table 5 contains Pasquill and wind speed data for 1800 GMT at Frankfurt. No observations were more than slightly unstable (C). During the summer more than two-thirds of the observations were made under neutral conditions. In winter a large majority of the observations were made under stable conditions. Wind speeds are comparable to those at 0600 GMT at Frankfurt.

Tables 6-9 consist of data for Hahn, West Germany, similar to the data for Frankfurt in Tables 2-5. Wind speeds are higher at Hahn in winter than in summer. A stable atmosphere is much more common than a neutral atmosphere at Hahn at 0000 GMT in the warmer part of the year, but in December and January neutral and stable conditions are almost equally probable. At 0600 GMT conditions are neutral approximately half the time during December through April, but during May through September about half of the observations are slightly unstable. At 1200 GMT the atmosphere is unstable more often than it is neutral throughout the year. However, the degree of instability is much greater during the warmer months. In fact, during June and July the atmosphere is in the highly unstable A category approximately one-third of the time. At 1800 GMT not one observation is more than slightly unstable in any month. Most observations are neutral during April through August, and most are very stable in March and September. In late fall and winter neither neutral nor stable observations are in an overwhelming majority.

Finally, data for Osan, Korea, are listed in Tables 10-13. Very stable conditions occur more than 85 percent of the time in every month at 0000 local Osan time. At 1200 local time unstable conditions predominate throughout the year, and during summer more than two-thirds of the observations are in the very unstable A category. At 0600 local time few observations are in the neutral D category. Most conditions are classified as very stable when the solar angle is negative, and most are classified as having some degree of instability when the solar angle is positive at 0600. Neutral stability occurs more frequently at 1800 hours. In May and in July a majority of observations are neutral at this time, and a large number are neutral in the months April through August.

The information in this section will be used later to establish a climatology by a procedure discussed in Section III.

### III. ESTIMATION OF TURBULENT FLUCTUATIONS

In the present study the standard deviations of the  $u$  and  $v$  components of the wind are estimated from formulae recommended by Weber et al. (1982). The  $u$  component is in the direction of the mean horizontal air motion, and the  $v$  component is in the direction of the horizontal coordinate perpendicular to the mean motion. The standard deviations of the  $u$  and  $v$  components are denoted by  $\sigma_u$  and  $\sigma_v$ , respectively.

Under stable conditions

$$\sigma_u = 2.0u_* (1-z/h) \quad (2)$$

and

$$\sigma_v = 1.3u_* (1-z/h) \quad (3)$$

where  $u_*$  is the friction velocity,  $z$  is height, and  $h$  is the scale height of the stable boundary layer.  $h$  is proportional to  $(u_*L/f)^{1/2}$ , where  $L$  is the Monin-Obukhov length (see p. 10) and  $f$  is the Coriolis parameter (defined as  $2\Omega \sin \phi$  where  $\Omega$  is the angular velocity of rotation of the earth and  $\phi$  is latitude,  $\Omega = 7.2921 \cdot 10^{-5}$  radians per second). There are several estimates of the constant of proportionality: 0.22 by Wyngaard (1975); 0.4 or greater by Nieuwstadt and Tennekes (1981); 0.6 by Mahrt et al. (1982); and 0.4 to 0.7 by Caughey et al. (1979). Apparently the constant of proportionality depends upon the state of development of the stable boundary layer. In this report  $h$  is computed by

$$h = 0.5 (u_*L/f)^{1/2} \quad (4)$$

Under neutral conditions

$$\sigma_u = 2.0u_* [\exp(-\frac{3}{2} fz/u_*)] \quad (5)$$

and

$$\sigma_v = 1.3u_* [\exp(-fz/u_*)] \quad (6)$$

Under unstable conditions

$$\sigma_u = \sigma_v = u_* (12 - 0.5 z_1/L)^{1/3} \quad (7)$$

where  $z_1$  is the depth of the mixed layer. Empirical evidence indicates that  $z_1$  may vary from less than 1.0 km to more than 2.0 km (Lenschow et al., 1980; Panofsky et al., 1977; Garrett, 1981; Kaimal et al., 1982). Considerable disagreement exists concerning parameterization of the height of the unstable boundary layer (Zilitinkevich, 1972; Deardorff, 1972, 1973, 1974; Tennekes, 1973; Wyngaard, 1973; Clarke and Hess, 1973; Benkley and Schulman, 1979; Højstrup, 1982). Therefore, it was decided to use a constant value of 1500 m for  $z_1$ .

The friction velocity  $u_*$  can be obtained from the equation

$$\bar{u} = \frac{u_*}{k} [\ln \frac{z}{z_0} - \psi(\frac{z}{L})] \quad (8)$$

where  $\bar{u}$  is a time average of  $u$ ,  $k$  is the von Karman constant,  $z_0$  is the roughness length, and  $\psi$  is a stability parameter. If  $z/L$  is zero,  $\psi = 0$ . Otherwise, one of the following equations is applicable:

$$\psi = -4.7 z/L \text{ for } z/L > 0 \quad (9)$$

or

$$\psi = 2 \ln [(1+X)/2] + \ln [(1+X^2)/2] - 2 \tan^{-1}(X) + \frac{\pi}{2} \text{ for } \frac{z}{L} < 0 \quad (10)$$

where  $X = [1-15 (z/L)]^{1/4}$  (Businger, 1973; Paulson, 1970). Wind speeds from a standard anemometer at 10 m can be used for  $\bar{u}$ , and therefore  $z$  in (8) is 10 m. The von Karman constant is now customarily taken to be 0.4. The roughness length  $z_0$  has somewhat arbitrarily been chosen as 0.5 m. This seemed reasonable for the environment of an airport where meteorological measurements are normally made. By comparison, a city typically has a  $z_0$  of 1-4 m, and  $z_0$  over ice may be a small fraction of a centimeter.

The remaining parameter which must be determined is the Monin-Obukhov length  $L$ .  $L$  is positive for stable conditions and negative for unstable conditions. The magnitude of  $L$  is seldom less than 10 m (Tennekes and Lumley, 1972), and no upper limit exists. Large magnitudes are associated with approximately neutral conditions, and  $L^{-1} = 0$  is the condition for complete neutrality. Weber et al. (1982) consider  $|z/L| < 0.05$  as the criterion for a nearly neutral planetary boundary layer. According to Wyngaard and Clifford (1977)  $L \approx 50$  m represents moderately stable conditions;  $L \approx -50$  m is associated with a moderately unstable atmosphere; and a very unstable atmosphere has  $L$  near  $-13$  m. According to Blackadar et al. (1974)  $L^{-1}$  can be estimated as a function of Pasquill category and  $z_0$ , and they provide a figure for doing this. From all of the above information, it was possible to estimate an average value of  $L^{-1}$  for each Pasquill category. Column 2 of Table 14 lists the values which were chosen.

It is now possible to obtain  $u_*$  from (8). Columns 3, 4, and 5 of Table 14 contain  $z/L$ ,  $\psi(z/L)$ , and  $(1/k) [\ln (z/z_0) - \psi (z/L)]$  which are needed for each Pasquill category. Table 15 records the magnitudes of  $u_*$  which are computed for each combination of wind speed and Pasquill category which is permitted according to the classification scheme used in this report. The original data were recorded to the nearest tenth of a meter per second. Therefore, the mean wind speed for each speed category is the mean of the meter-per-second values which are permitted in that category. It was assumed that all values in each category were equal to the mean value for  $V < 12$  knots (6.1728 m/s). The category  $V > 12$  knots is open-ended, and it is not realistic to let one value represent the whole category. It was assumed that half of the observations were represented by each of the two values of  $u_m$  for  $V > 12$  knots.

The effect of these assumptions can be seen by making a sample calculation from Table 4 for Frankfurt at 1200 GMT. Consider the number of  $\sigma_u$  greater than 2.0 m/s for fall (September, October, and November). All 21 observations for which the Pasquill category is B and  $6 < V < 7$  are classified as  $\sigma_u > 2.0$  m/s because the computed  $\sigma_u$  associated with the  $u_*$  from Table 15 is 2.02 m/s. No attempt is made to represent a distribution of values over the wind speed category or over the stability category. In addition, 16 other observations from category B and 13 from category C fall into the group  $\sigma_u > 2.0$  m/s, which is a total of 50. In category D there are 111 observations for which  $12 \leq V$  in fall. Half of these (rounded to 56) were counted as  $\sigma_u = 1.96$  m/s and half (55) have  $\sigma_u = 2.14$  m/s. Thus, in our tabulation (Table 16) 105 of 601, or 17.5 percent, of the observations were placed into the group  $\sigma_u > 2.0$  m/s. If all 111 observations for  $12 \leq V$  had to be classified as  $\sigma_u > 2.0$  m/s, we would have to add 56 more into the group  $\sigma_u > 2.0$  m/s, which amounts to a total of 26.8 percent. It would be an extreme case, however, if all 56 observations would have to be counted into the  $\sigma_u > 2.0$  m/s class. Thus, our estimates in the  $\sigma_u > 2.0$  m/s class could have been somewhat higher, but others placed into the  $\sigma_u > 2.0$  m/s group may be lower than 2.0 m/s. Thus, the statistical estimates by our simplified method are reasonable.

The theoretical framework developed in this section was applied to observational data in Section II to obtain frequency distributions of the standard deviation of the wind which are presented in the next section.

#### IV. CLIMATOLOGY OF TURBULENT FLUCTUATIONS

Stewart (1981) reviewed and summarized measurements of the intensity of turbulence in the planetary boundary layer. The intensity of turbulence is generally greater over rough surfaces than over smooth surfaces, and turbulence is normally stronger under unstable conditions than under stable conditions. Unfortunately, routine measurements of turbulence characteristics have not been made at any one location for a long enough period to establish a climatology.

Because measurements are not available, it is necessary to estimate climatological information, and the method described in Section III is used here. Seasonal frequency distributions of  $\sigma_u$  for Frankfurt are given in Table 16. More than half of the standard deviations are less than 0.5 m/s during all seasons at 0000 GMT, during fall and winter at 1800 GMT, and during winter at 0600 GMT. At 1200 GMT fewer than 15 percent of the standard deviations are below 0.5 m/s during all seasons. During summer at 1200 GMT 57.4 percent of the standard deviations are greater than 2.0 m/s, and during spring 37.1 percent of the  $\sigma_u$ 's are greater than 2.0 m/s. During fall and winter at 1200 GMT the majority of the standard deviations are between 1.0 and 2.0 m/s.

Table 17 contains the seasonal frequency distributions of  $\sigma_u$  for Hahn, and they are quite similar to those at Frankfurt. Turbulence is greater at

Hahn than at Frankfurt at all hours in winter, but there is no consistent pattern to the small differences during the other seasons.

Data from Osan, Korea, are shown in Table 18. There are more values of  $\sigma_u$  less than 0.5 m/s at Osan than at either of the German stations at all times throughout the year. One of the biggest reasons that wind fluctuations are smaller at Osan is that wind speeds are smaller than at the German stations.

Annual frequencies of standard deviations of the u component of the wind speed at some other locations can be estimated from Reiquam's (1980) data. Categories E and F are combined in Reiquam's data, but this does not pose a serious problem. The E-F observations in the 0-3 mi/hr (0 - 1.34 m/s) speed category are F, and those in the 7-10 mi/hr (3.13 - 4.47 m/s) category are E. It was decided that observations in the E-F stability category and the 4-6 mi/hr (1.79 - 2.68 m/s) wind speed category should be equally divided between E and F.

Table 19 contains estimates of the annual percentage of the  $\sigma_u$  in different categories for four locations in the United States. One location is Moorcroft, Wyoming, and a second is a project site approximately 80 kilometers away. A third location is Farmington, New Mexico, and a fourth is a project site nearly 65 kilometers from Farmington. In New Mexico and in Wyoming the more rural project sites have higher  $\sigma_u$ 's even though neither Moorcroft nor Farmington is a large city which would be expected to alter the environment drastically. Moorcroft has an annual average similar to Frankfurt. None of the American stations is similar to Osan where nearly two-thirds of the  $\sigma_u$ 's are less than 0.5 m/s. It is difficult to form too many conclusions from Reiquam's data because it is for only one year and is not broken down by time of year or time of day.

## V. SUMMARY AND CONCLUSIONS

This report includes climatological information about wind speed, atmospheric stability, and turbulent wind fluctuations.

The appendix contains frequency distributions of observed surface wind speeds at 35 stations located throughout the Northern Hemisphere. As expected, the frequency distributions are normally asymmetrical and skewed to the right in all seasons. The overall average mean is 10 percent greater than the median. The ratio of the standard deviation to the mean is between 0.4 and 1.0 for almost every frequency distribution. Mean wind speeds are generally larger in the cooler part of the year than in the warmer part of the year.

In Section II observations from two German stations and one Korean station are classified as a function of wind speed and stability category. The classification of atmospheric stability was made by means of the Pasquill method, which uses standard surface meteorological data. At night, conditions are stable or neutral, and in the middle of the night stable conditions predominate at all stations. In the middle of the day, the atmosphere is unstable more often than it is neutral throughout the year, and in the summer nearly all observations are unstable. The highest wind speeds occur during the day and under neutral or slightly unstable conditions.

In Section III, a procedure is outlined to estimate standard deviations of turbulent wind fluctuations from wind speed and stability, and in Section IV turbulence climatologies are estimated by this procedure. More than 90 percent of the  $\sigma_u$ 's are less than 2.0 m/s between sunset and sunrise throughout the year. Near the middle of the day approximately half of the  $\sigma_u$ 's are greater than 2.0 m/s in summer, and more than one-third are greater than 2.0 m/s in spring. It is hoped that more stations can be examined in the future.

TABLE 1. Pasquill stability category (A through F) as a function of wind speed (V) in knots (1 knot = 0.5144 m/s) and net radiative index (NRI).

WIND SPEED (KNOTS)	NRI						
	1	2	3	4	5	6	7
$0 \leq V < 2$	A	A	B	C	D	F	F
$2 \leq V < 4$	A	B	B	C	D	F	F
$4 \leq V < 6$	A	B	C	D	D	E	F
$6 \leq V < 7$	B	B	C	D	D	E	F
$7 \leq V < 8$	B	B	C	D	D	D	E
$8 \leq V < 10$	B	C	C	D	D	D	E
$10 \leq V < 11$	C	C	D	D	D	D	E
$11 \leq V < 12$	C	C	D	D	D	D	D
$12 \leq V$	C	D	D	D	D	D	D

TABLE 2. Number of observations at 0000 GMT as a function of Pasquill stability category and wind speed at Frankfurt for the period 17 February 1969 through 31 March 1977. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
D	0<V<2	4	2	0	0	1	0	0	0	0	11	4	4
	2<V<4	1	0	0	0	0	0	1	0	0	4	2	3
	4<V<6	1	0	0	0	0	0	0	0	0	2	3	3
	6<V<7	0	0	0	0	0	0	0	0	0	0	0	0
	7<V<8	6	8	6	2	2	2	2	2	1	2	6	8
	8<V<10	3	7	11	6	4	3	3	3	3	6	9	13
	10<V<11	0	4	5	4	2	1	0	0	2	2	6	3
	11<V<12	3	5	3	1	1	3	4	1	1	2	4	5
	12<V	24	8	13	12	5	1	1	0	4	8	26	18
	TOTAL	42	34	38	25	15	10	11	6	11	37	60	57
E	4<V<6	25	16	17	3	13	5	7	1	11	11	14	16
	6<V<7	5	7	11	8	2	1	0	2	0	6	2	7
	7<V<8	1	6	0	5	3	2	2	4	0	5	5	8
	8<V<10	9	7	8	7	10	8	4	8	6	4	7	9
	10<V<11	4	4	3	2	1	1	1	1	1	2	4	3
	TOTAL	44	40	39	25	29	17	14	16	18	28	32	43
F	0<V<2	48	40	38	27	27	24	23	28	49	35	40	36
	2<V<4	38	35	31	18	15	24	21	20	21	43	28	41
	4<V<6	15	8	14	16	8	8	15	12	6	16	12	8
	6<V<7	4	4	5	5	8	5	1	12	2	4	9	7
	TOTAL	105	87	88	66	58	61	60	72	78	98	89	92

TABLE 3 . Number of observations at 0600 GMT as a function of Pasquill stability category and wind speed at Frankfurt for the period 17 February 1969 through 31 March 1977. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	0≤V<2	0	0	0	0	0	0	0	1	0	0	0	0
	2≤V<4	0	0	0	0	0	0	0	0	0	0	0	0
	4≤V<6	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	0	0	0	1	0	0	0	0
B	0≤V<2	0	0	1	8	35	30	37	23	9	3	0	0
	2≤V<4	0	0	1	10	27	28	34	24	1	3	0	0
	4≤V<6	0	0	0	0	0	0	0	0	0	0	0	0
	6≤V<7	0	0	0	0	0	0	0	0	0	0	0	0
	7≤V<8	0	0	0	0	0	0	0	0	0	0	0	0
	8≤V<10	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	2	18	62	58	71	47	10	6	0	0
C	0≤V<2	0	0	42	29	2	2	1	17	62	13	0	0
	2≤V<4	0	0	55	23	1	1	0	16	36	15	0	0
	4≤V<6	0	0	1	5	31	36	39	18	0	0	0	0
	6≤V<7	0	0	0	4	24	15	19	12	0	0	0	0
	7≤V<8	0	0	0	5	16	12	21	6	0	0	0	0
	8≤V<10	0	0	0	7	14	15	11	8	0	0	0	0
	10≤V<11	0	0	0	0	0	0	0	0	0	0	0	0
	11≤V<12	0	0	0	0	0	0	0	0	0	0	0	0
	12≤V	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	98	73	88	81	91	77	98	28	0	0
D	0≤V<2	8	7	0	0	0	0	0	0	0	12	5	5
	2≤V<4	3	2	0	0	0	0	0	0	0	6	6	4
	4≤V<6	2	1	34	16	3	0	0	19	39	13	5	5
	6≤V<7	0	0	15	13	1	1	0	6	12	4	0	0
	7≤V<8	3	2	9	9	1	0	0	6	8	5	6	10
	8≤V<10	7	7	20	11	1	1	0	9	12	5	16	12
	10≤V<11	1	4	15	13	6	5	4	4	3	4	7	5
	11≤V<12	4	2	7	4	3	4	6	2	4	3	9	5
	12≤V	28	19	18	17	9	11	7	1	10	9	25	21
	TOTAL	56	44	118	83	24	22	17	47	88	61	79	67
E	4≤V<6	14	15	2	0	0	0	0	0	0	9	7	17
	6≤V<7	6	3	0	0	0	0	0	0	0	2	7	8
	7≤V<8	5	6	0	0	0	0	0	0	0	8	4	8
	8≤V<10	7	11	2	0	0	0	0	0	0	13	12	12
	10≤V<11	8	4	1	0	0	0	0	0	0	4	1	5
	TOTAL	40	39	5	0	0	0	0	0	0	36	31	50
F	0≤V<2	57	41	4	0	0	0	0	0	0	25	38	42
	2≤V<4	45	41	5	0	0	0	0	0	0	39	31	34
	4≤V<6	15	24	1	0	0	0	0	0	0	16	18	9
	6≤V<7	6	6	1	0	0	0	0	0	0	4	12	13
	TOTAL	123	112	11	0	0	0	0	0	0	84	99	98

TABLE 4. Number of observations at 1200 GMT as a function of Pasquill stability category and wind speed at Frankfurt for the period 17 February 1969 through 31 March 1977. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	0<V<2	3	0	7	10	15	9	8	14	15	4	2	1
	2<V<4	0	0	0	0	3	26	7	0	0	0	0	0
	4<V<6	0	0	0	0	8	37	18	0	0	0	0	0
	TOTAL	3	0	7	10	26	72	33	14	15	4	2	1
B	0<V<2	30	20	6	0	0	0	1	0	0	29	20	21
	2<V<4	28	23	33	21	19	0	12	21	40	28	20	24
	4<V<6	0	1	28	23	25	1	23	28	32	1	2	1
	6<V<7	0	0	10	7	13	19	17	19	21	0	0	0
	7<V<8	0	1	8	10	10	13	15	13	15	0	1	1
	8<V<10	0	0	0	0	7	22	17	0	0	0	0	0
	TOTAL	58	45	85	61	74	55	85	81	108	58	43	47
C	0<V<2	6	3	0	0	0	0	0	0	0	2	6	7
	2<V<4	7	5	1	0	0	0	0	0	0	1	1	5
	4<V<6	28	29	14	0	0	0	0	0	0	30	23	29
	6<V<7	13	16	6	0	0	0	0	0	0	19	6	20
	7<V<8	10	18	11	0	0	0	0	0	0	6	20	16
	8<V<10	20	20	33	17	13	0	16	28	20	33	29	23
	10<V<11	0	0	8	14	15	13	10	5	4	0	0	0
	11<V<12	0	0	6	11	9	6	4	6	9	0	0	0
	12<V	0	0	0	0	16	25	10	0	0	0	0	0
	TOTAL	84	91	79	42	53	44	40	39	33	91	85	100
D	4<V<6	9	7	1	0	0	0	0	0	0	4	0	7
	6<V<7	2	4	0	0	0	0	0	0	0	0	1	3
	7<V<8	4	1	1	0	0	0	0	0	0	1	2	3
	8<V<10	2	1	0	1	0	0	0	0	0	2	2	5
	10<V<11	11	12	5	0	0	0	0	0	0	5	15	18
	11<V<12	10	13	5	1	0	0	0	0	0	5	14	10
	TOTAL	73	73	60	61	19	2	9	26	32	29	50	32

TABLE 5 . Number of observations at 1800 GMT as a function of Pasquill stability category and wind speed at Frankfurt for the period 17 February 1969 through 31 March 1977. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	0<V<2	0	0	0	0	0	0	0	0	0	0	0	0
	2<V<4	0	0	0	0	0	0	0	0	0	0	0	0
	4<V<6	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0
B	0<V<2	0	0	0	0	0	0	0	0	0	0	0	0
	2<V<4	0	0	0	0	0	0	0	0	0	0	0	0
	4<V<6	0	0	0	0	0	0	0	0	0	0	0	0
	6<V<7	0	0	0	0	0	0	0	0	0	0	0	0
	7<V<8	0	0	0	0	0	0	0	0	0	0	0	0
	8<V<10	0	0	0	0	0	0	0	0	0	0	0	0
C	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0
	0<V<2	0	0	0	8	20	15	12	19	0	0	0	0
	2<V<4	0	0	0	17	24	20	20	27	0	0	0	0
	4<V<6	0	0	0	0	0	0	0	0	0	0	0	0
	6<V<7	0	0	0	0	0	0	0	0	0	0	0	0
	7<V<8	0	0	0	0	0	0	0	0	0	0	0	0
	8<V<10	0	0	0	0	0	0	0	0	0	0	0	0
	10<V<11	0	0	0	0	0	0	0	0	0	0	0	0
	11<V<12	0	0	0	0	0	0	0	0	0	0	0	0
	12<V	0	0	0	0	0	0	0	0	0	0	0	0
D	TOTAL	0	0	0	25	44	35	32	46	0	0	0	0
	0<V<2	3	1	0	0	0	0	0	0	0	4	4	2
	2<V<4	0	0	0	0	0	0	0	0	0	1	3	0
	4<V<6	0	1	0	18	22	37	24	26	0	1	0	4
	6<V<7	0	0	1	18	12	10	12	8	0	0	0	0
	7<V<8	3	2	4	13	13	14	11	5	3	1	6	6
	8<V<10	10	6	7	16	16	13	17	13	2	6	4	8
	10<V<11	3	1	2	4	7	5	7	7	0	1	1	4
	11<V<12	8	6	12	8	8	10	2	3	2	2	10	6
	12<V	21	20	18	16	13	8	9	6	3	14	27	20
E	TOTAL	48	37	44	93	91	97	82	68	10	30	55	50
	4<V<6	14	8	12	1	0	0	0	0	3	5	16	24
	6<V<7	3	7	6	0	0	0	0	0	2	5	2	10
	7<V<8	6	5	7	2	0	0	0	0	5	5	3	5
	8<V<10	12	13	13	4	0	0	0	0	8	8	12	15
	10<V<11	3	2	7	3	0	0	0	0	5	1	4	6
F	TOTAL	38	35	46	10	0	0	0	0	23	24	37	60
	0<V<2	48	39	28	6	0	0	0	0	26	38	34	36
	2<V<4	43	47	31	9	0	0	0	0	18	30	29	39
	4<V<6	16	15	18	5	0	0	0	0	20	16	15	9
	6<V<7	6	7	5	3	0	0	0	0	11	6	3	1
F	TOTAL	113	108	82	23	0	0	0	0	75	90	81	85

TABLE 6 . Number of observations at 0000 GMT as a function of Pasquill stability category and wind speed at Hahn for the period 11 March 1969 through 31 December 1976. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
D	0<V<2	3	1	4	1	0	0	1	0	3	2	6	0
	2<V<4	4	2	1	1	0	1	0	1	1	3	5	3
	4<V<6	8	4	4	2	1	1	0	1	1	6	1	5
	6<V<7	0	0	0	0	1	0	0	0	0	1	1	5
	7<V<8	8	10	6	5	13	5	2	1	2	11	7	8
	8<V<10	18	9	9	7	6	3	4	3	6	5	9	22
	10<V<11	1	1	2	3	0	1	0	1	1	3	1	0
	11<V<12	9	5	6	4	0	4	2	2	1	3	10	11
	12<V	30	22	11	9	6	3	1	0	7	7	24	18
	TOTAL	81	54	43	32	27	18	10	9	22	41	64	72
E	4<V<6	8	15	13	10	11	5	1	11	11	6	11	10
	6<V<7	5	4	7	3	4	3	1	2	0	1	2	5
	7<V<8	10	10	8	14	9	11	2	8	3	12	13	7
	8<V<10	15	17	10	11	6	8	6	9	5	11	16	12
	10<V<11	6	2	4	2	0	3	0	0	0	2	1	3
	TOTAL	44	48	42	40	30	30	10	30	19	32	43	37
F	0<V<2	14	12	26	31	31	38	46	54	51	20	15	8
	2<V<4	10	17	27	33	34	44	49	44	33	29	17	20
	4<V<6	11	10	17	23	38	30	26	34	16	11	23	18
	6<V<7	6	5	11	7	12	8	11	6	7	10	9	4
	TOTAL	41	44	81	94	115	120	132	138	107	70	64	50

TABLE 7. Number of observations at 0600 GMT as a function of Pasquill stability category and wind speed at Hahn for the period 11 March 1969 through 31 December 1976. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	0<V<2	0	0	0	0	1	0	1	0	0	0	0	0
	2<V<4	0	0	0	0	0	0	0	0	0	0	0	0
	4<V<6	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	1	0	1	0	0	0	0	0
B	0<V<2	0	0	0	1	31	18	18	13	2	0	0	0
	2<V<4	0	0	3	9	27	42	43	23	5	2	0	0
	4<V<6	0	0	0	0	0	1	2	0	0	0	0	0
	6<V<7	0	0	0	0	1	2	0	0	0	0	0	0
	7<V<8	0	0	0	0	0	0	1	0	0	0	0	0
	8<V<10	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	3	10	59	63	64	36	7	2	0	0
C	0<V<2	0	0	28	22	3	1	2	24	47	2	0	0
	2<V<4	0	0	21	24	1	2	0	28	35	3	0	0
	4<V<6	0	0	2	12	46	38	41	22	5	0	0	0
	6<V<7	0	0	1	4	15	14	13	2	0	0	0	0
	7<V<8	0	0	0	3	14	14	11	6	1	0	0	0
	8<V<10	0	0	2	3	18	20	14	9	0	1	0	0
	10<V<11	0	0	0	0	0	0	0	0	0	0	0	0
	11<V<12	0	0	0	0	0	1	0	0	0	0	0	0
	12<V	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	54	68	97	90	81	91	88	6	0	0
D	0<V<2	3	3	0	0	0	0	0	0	0	1	4	1
	2<V<4	7	4	0	0	0	0	0	0	0	2	2	2
	4<V<6	3	1	21	29	2	3	5	28	32	7	5	13
	6<V<7	3	4	8	12	1	2	4	6	9	3	1	4
	7<V<8	12	14	14	9	4	6	3	6	8	6	7	7
	8<V<10	14	16	19	20	5	3	3	11	11	18	17	12
	10<V<11	3	3	6	3	1	2	0	0	4	5	4	3
	11<V<12	10	14	7	5	5	4	1	4	3	6	8	13
	12<V	32	16	13	14	8	3	3	3	9	9	34	30
	TOTAL	87	75	88	92	26	23	19	58	76	57	82	85
E	4<V<6	8	4	2	0	0	0	0	0	0	9	7	9
	6<V<7	5	4	1	0	0	0	0	0	0	1	5	6
	7<V<8	7	5	4	0	0	0	0	0	0	4	11	10
	8<V<10	14	13	1	0	0	0	0	0	0	10	9	9
	10<V<11	4	7	2	0	0	0	0	0	0	0	5	6
	TOTAL	38	33	10	0	0	0	0	0	0	24	37	40
F	0<V<2	7	16	10	0	0	0	0	0	0	20	21	19
	2<V<4	17	16	4	0	0	0	0	0	0	30	22	18
	4<V<6	9	10	5	0	0	0	0	0	0	16	16	14
	6<V<7	6	3	1	0	0	0	0	0	0	11	7	2
	TOTAL	39	45	20	0	0	0	0	0	0	77	66	53

TABLE 8 . Number of observations at 1200 GMT as a function of Pasquill stability category and wind speed at Hahn for the period 11 March 1969 through 31 December 1976. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	0<V<2	2	0	13	12	11	11	8	12	18	2	1	1
	2<V<4	0	0	0	0	8	23	23	0	1	0	0	0
	4<V<6	0	0	0	1	13	34	21	1	0	0	0	0
	TOTAL	2	0	13	13	32	68	52	13	19	2	1	1
B	0<V<2	10	7	2	0	0	1	0	0	0	8	9	5
	2<V<4	14	7	29	12	16	1	8	23	27	20	21	19
	4<V<6	2	1	20	32	21	0	19	36	36	3	4	3
	6<V<7	1	1	6	15	18	18	8	19	17	2	2	3
	7<V<8	4	0	13	21	24	30	30	18	8	1	2	8
	8<V<10	0	0	0	0	10	30	22	0	1	0	0	0
	TOTAL	31	16	70	80	89	80	87	96	89	34	38	38
C	0<V<2	2	1	0	0	1	0	1	0	0	0	1	5
	2<V<4	1	2	1	1	0	0	1	1	0	5	4	4
	4<V<6	11	20	14	2	1	0	2	1	1	34	21	22
	6<V<7	6	9	2	1	2	1	0	0	1	9	10	10
	7<V<8	13	9	7	0	0	1	0	2	1	19	15	8
	8<V<10	35	31	33	43	26	0	11	28	28	27	26	24
	10<V<11	2	0	6	8	8	6	5	9	5	0	0	1
	11<V<12	4	2	4	11	6	10	6	14	5	0	0	0
	12<V	0	0	1	0	6	12	7	0	0	0	0	0
	TOTAL	74	74	68	66	50	30	33	55	41	94	77	74
D	4<V<6	2	2	2	0	0	0	2	1	0	4	1	4
	6<V<7	5	4	1	1	0	0	0	1	0	2	2	3
	7<V<8	2	1	2	1	1	0	0	0	0	4	5	5
	8<V<10	4	6	1	3	0	0	0	0	0	3	3	1
	10<V<11	8	7	1	0	1	0	0	2	1	4	3	8
	11<V<12	18	9	4	0	1	0	0	0	0	10	15	9
	12<V	30	30	26	28	8	0	2	17	19	24	43	38
	TOTAL	69	59	37	33	11	0	4	21	20	51	72	68

TABLE 9 . Number of observations at 1800 GMT as a function of Pasquill stability category and wind speed at Hahn for the period 11 March 1969 through 31 December 1976. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	0<V<2	0	0	0	0	0	0	0	0	0	0	0	0
	2<V<4	0	0	0	0	0	0	0	0	0	0	0	0
	4<V<6	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0
B	0<V<2	0	0	0	0	0	0	0	0	0	0	0	0
	2<V<4	0	0	0	0	0	0	0	0	0	0	0	0
	4<V<6	0	0	0	0	0	0	0	0	0	0	0	0
	6<V<7	0	0	0	0	0	0	0	0	0	0	0	0
	7<V<8	0	0	0	0	0	0	0	0	0	0	0	0
	8<V<10	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0
C	0<V<2	0	0	0	22	24	12	24	29	3	0	0	0
	2<V<4	0	0	0	28	36	31	38	55	6	0	0	0
	4<V<6	0	0	0	1	0	1	0	0	0	0	0	0
	6<V<7	0	0	0	0	0	0	0	0	0	0	0	0
	7<V<8	0	0	0	0	0	0	0	1	0	0	0	0
	8<V<10	0	0	0	0	0	0	0	0	0	0	0	0
	10<V<11	0	0	0	0	0	0	0	0	0	0	0	0
	11<V<12	0	0	0	0	0	0	0	0	0	0	0	0
	12<V	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	51	60	44	62	85	9	0	0	0
D	0<V<2	1	1	0	0	0	0	0	0	0	2	6	0
	2<V<4	4	4	1	0	0	0	0	0	0	0	2	3
	4<V<6	7	3	0	33	50	49	46	45	6	2	6	7
	6<V<7	2	2	0	10	15	23	22	14	2	3	0	7
	7<V<8	6	5	6	17	24	21	15	25	6	12	4	9
	8<V<10	13	6	7	28	19	23	15	16	4	11	6	19
	10<V<11	5	1	0	2	2	5	4	0	1	1	1	3
	11<V<12	15	8	5	6	7	9	4	4	4	6	6	13
	12<V	30	19	15	14	8	6	2	3	6	11	34	31
	TOTAL	83	49	34	110	125	136	108	107	29	48	65	92
E	4<V<6	14	6	11	3	0	0	0	0	7	7	8	8
	6<V<7	1	4	2	0	0	0	0	0	2	1	3	5
	7<V<8	8	12	15	0	0	0	0	0	3	14	10	4
	8<V<10	15	8	15	1	0	0	0	0	8	16	19	20
	10<V<11	5	3	2	0	0	0	0	0	1	1	3	4
	TOTAL	43	33	45	4	0	0	0	0	21	39	43	41
F	0<V<2	18	20	28	5	0	0	0	0	46	28	12	19
	2<V<4	9	19	45	2	0	0	0	0	33	31	25	9
	4<V<6	11	23	22	5	0	0	0	0	25	24	16	13
	6<V<7	7	11	7	0	0	0	0	0	5	5	10	6
	TOTAL	45	73	102	12	0	0	0	0	109	88	63	47

TABLE 10. Number of observations at 0000 local time as a function of Pasquill stability category and wind speed at Osan for the period 1 January 1973 through 31 December 1979. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
D	0<V<2	1	0	1	1	2	1	1	1	1	3	0	1
	2<V<4	0	0	0	0	3	0	0	0	0	0	0	0
	4<V<6	0	0	0	0	0	0	1	0	0	0	0	0
	6<V<7	0	0	0	0	0	0	0	0	0	0	0	0
	7<V<8	1	2	2	3	2	4	0	3	2	1	0	3
	8<V<10	1	2	1	2	2	1	0	2	1	0	5	1
	10<V<11	1	0	1	0	0	0	1	0	0	0	2	0
	11<V<12	3	1	2	0	3	2	1	0	0	2	3	2
	12<V	0	1	0	2	3	0	1	2	1	1	3	1
	TOTAL	7	6	7	8	15	8	5	8	5	7	13	8
E	4<V<6	4	9	5	6	4	5	7	6	4	3	7	4
	6<V<7	2	2	1	1	1	1	1	2	1	0	0	1
	7<V<8	4	3	4	3	1	3	1	0	1	5	2	1
	8<V<10	6	4	4	0	1	2	2	0	0	0	3	3
	10<V<11	0	1	0	1	1	0	1	1	0	0	1	0
	TOTAL	16	19	14	11	8	11	12	9	6	8	13	9
F	0<V<2	127	101	125	109	150	142	140	154	161	137	122	123
	2<V<4	39	44	44	52	25	33	44	33	30	49	48	62
	4<V<6	15	10	9	12	9	11	10	9	5	10	9	12
	6<V<7	2	6	0	4	0	1	3	1	1	2	2	2
	TOTAL	183	161	178	177	184	187	197	197	197	198	181	199

TABLE 11. Number of observations at 0600 local time as a function of Pasquill stability category and wind speed at Qsar for the period 1 January 1973 through 31 December 1979. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	0<V<2	0	0	0	0	2	1	2	3	0	0	0	0
	2<V<4	0	0	0	0	0	0	0	0	0	0	0	0
	4<V<6	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	2	1	2	3	0	0	0	0
B	0<V<2	0	0	1	0	107	122	104	28	8	7	0	0
	2<V<4	0	0	0	2	36	28	51	10	1	0	0	0
	4<V<6	0	0	0	0	0	1	0	0	0	0	0	0
	6<V<7	0	0	0	0	0	0	0	0	0	0	0	0
	7<V<8	0	0	0	0	1	0	0	0	0	0	0	0
	8<V<10	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	1	2	144	151	155	38	9	7	0	0
C	0<V<2	0	16	135	113	18	20	7	112	154	65	0	0
	2<V<4	0	2	41	41	10	10	10	34	26	11	0	0
	4<V<6	0	0	0	0	12	14	27	3	1	0	0	0
	6<V<7	0	0	0	0	1	1	2	0	0	0	0	0
	7<V<8	0	0	0	0	5	2	3	1	0	0	0	0
	8<V<10	0	0	0	0	3	3	2	1	0	0	0	0
	10<V<11	0	0	0	0	0	0	0	0	0	0	0	0
	11<V<12	0	0	0	0	0	0	0	0	0	0	0	0
	12<V	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	18	176	154	49	50	51	151	181	76	0	0
D	0<V<2	2	0	0	0	0	0	0	0	0	7	5	6
	2<V<4	0	0	0	0	0	0	0	0	0	1	0	1
	4<V<6	0	3	14	20	5	2	1	12	5	1	0	0
	6<V<7	0	0	1	7	0	0	1	1	0	0	0	0
	7<V<8	0	3	1	3	0	0	0	0	3	2	3	2
	8<V<10	2	1	6	4	2	1	1	4	2	0	3	1
	10<V<11	0	1	0	0	0	0	1	1	0	0	1	0
	11<V<12	2	1	2	1	0	0	1	1	0	0	0	1
	12<V	1	0	0	3	1	1	1	1	3	0	1	2
	TOTAL	7	9	24	38	8	4	6	20	13	11	13	13
E	4<V<6	4	6	0	0	0	0	0	0	0	3	6	7
	6<V<7	1	0	0	0	0	0	0	0	0	1	1	1
	7<V<8	2	2	0	0	0	0	0	0	0	3	2	1
	8<V<10	2	2	0	0	0	0	0	0	0	1	1	0
	10<V<11	0	0	0	0	0	0	0	0	0	0	1	0
	TOTAL	9	10	0	0	0	0	0	0	0	8	11	9
F	0<V<2	124	102	0	0	0	0	0	0	0	85	127	132
	2<V<4	47	33	0	0	0	0	0	0	0	18	43	45
	4<V<6	13	9	0	0	0	0	0	0	0	10	5	13
	6<V<7	1	4	0	0	0	0	0	0	0	0	2	3
	TOTAL	185	148	0	0	0	0	0	0	0	113	177	193

TABLE 12. Number of observations at 1200 local time as a function of Pasquill stability category and wind speed at Osan for the period 1 January 1973 through 31 December 1979. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	0<V<2	0	34	33	32	43	53	38	53	55	65	15	0
	2<V<4	0	0	0	27	44	52	51	57	0	0	0	0
	4<V<6	0	0	0	15	39	47	45	37	0	0	0	0
	TOTAL	0	34	33	74	126	152	134	147	55	65	15	0
B	0<V<2	51	7	6	2	0	1	0	0	1	5	33	62
	2<V<4	33	36	31	14	7	3	0	3	52	45	47	37
	4<V<6	0	25	41	12	6	2	2	3	48	32	4	0
	6<V<7	0	6	12	10	18	16	20	11	15	14	3	0
	7<V<8	0	15	13	18	14	12	16	15	9	18	5	0
	8<V<10	0	0	0	9	15	12	19	15	0	0	0	0
	TOTAL	84	89	103	65	60	46	57	47	125	114	92	99
C	0<V<2	11	0	2	0	0	0	0	0	1	0	8	14
	2<V<4	3	1	1	0	0	0	0	0	0	0	3	0
	4<V<6	31	2	3	1	1	0	1	1	0	0	27	27
	6<V<7	10	4	2	0	0	0	0	0	0	0	10	10
	7<V<8	9	1	4	1	0	0	0	0	0	1	7	15
	8<V<10	18	26	19	5	1	0	1	2	13	16	15	15
	10<V<11	0	3	3	6	4	2	5	3	2	4	0	0
	11<V<12	0	8	8	13	6	2	4	4	2	1	1	0
	12<V	0	0	0	14	11	3	4	9	0	0	0	0
	TOTAL	82	45	42	40	23	7	15	19	18	22	71	82
D	4<V<6	5	0	0	0	0	0	0	0	0	0	0	8
	6<V<7	0	0	0	1	0	0	0	0	0	0	1	0
	7<V<8	0	1	0	0	0	0	0	0	0	0	2	3
	8<V<10	2	0	0	0	0	0	0	0	0	0	0	0
	10<V<11	2	0	2	0	0	0	0	0	0	0	6	4
	11<V<12	10	2	0	0	0	0	0	0	0	0	5	5
	12<V	22	14	28	16	1	1	0	0	9	13	17	13
	TOTAL	41	17	30	17	1	1	0	0	9	13	31	33

TABLE 13. Number of observations at 1800 local time as a function of Pasquill stability category and wind speed at Osan for the period 1 January 1973 through 31 December 1979. V is in knots (1 knot = 0.5144 m/s).

PASQUILL CATEGORY	WIND SPEED	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	0<V<2	0	0	0	0	0	0	0	0	0	0	0	0
	2<V<4	0	0	0	0	0	0	0	0	0	0	0	0
	4<V<6	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0
B	0<V<2	0	0	0	0	0	0	0	0	0	0	0	0
	2<V<4	0	0	0	0	0	0	0	0	0	0	0	0
	4<V<6	0	0	0	0	0	0	0	0	0	0	0	0
	6<V<7	0	0	0	0	0	0	0	0	0	0	0	0
	7<V<8	0	0	0	0	0	0	0	0	0	0	0	0
	8<V<10	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0
C	0<V<2	0	0	0	23	35	60	45	80	0	0	0	0
	2<V<4	0	0	0	26	53	43	56	60	0	0	0	0
	4<V<6	0	0	0	1	0	0	0	0	0	0	0	0
	6<V<7	0	0	0	0	0	0	0	0	0	0	0	0
	7<V<8	0	0	0	0	0	0	0	0	0	0	0	0
	8<V<10	0	0	0	0	0	0	0	0	0	0	0	0
	10<V<11	0	0	0	0	0	0	0	0	0	0	0	0
	11<V<12	0	0	0	0	0	0	0	0	0	0	0	0
	12<V	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	50	88	103	101	140	0	0	0	0
D	0<V<2	0	1	0	0	0	0	0	0	0	0	0	1
	2<V<4	0	0	0	0	0	0	0	0	0	0	0	0
	4<V<6	0	0	0	23	58	51	62	29	0	0	0	0
	6<V<7	0	1	0	8	17	19	15	4	0	0	0	0
	7<V<8	0	2	3	15	17	13	17	7	5	0	4	3
	8<V<10	3	4	4	10	21	11	11	4	1	1	5	1
	10<V<11	0	0	0	0	1	0	2	0	0	0	0	0
	11<V<12	4	3	6	6	2	2	1	1	0	0	1	1
	12<V	1	3	6	9	4	2	2	1	1	3	1	3
	TOTAL	8	14	19	71	120	98	110	46	7	4	11	9
E	4<V<6	7	9	11	7	0	0	0	4	3	1	5	2
	6<V<7	1	2	1	3	0	0	0	0	1	2	3	1
	7<V<8	4	5	13	4	0	0	0	0	2	1	2	3
	8<V<10	3	6	10	7	0	0	0	0	0	2	6	4
	10<V<11	1	0	4	0	0	0	0	0	0	0	2	2
	TOTAL	16	22	39	21	0	0	0	4	6	6	18	12
F	0<V<2	130	77	72	16	0	0	0	6	130	159	131	144
	2<V<4	33	41	36	22	0	0	0	10	48	32	35	37
	4<V<6	13	26	33	15	0	0	0	6	17	11	9	11
	6<V<7	5	4	7	4	0	0	0	1	0	2	4	2
	TOTAL	181	148	148	57	0	0	0	23	195	204	179	194

TABLE 14. Parameters needed for the computation of  $u_*$  from wind speed at  $z = 10\text{m}$  when  $z_0 = 0.5\text{m}$ .

PASQUILL CATEGORY	$L^{-1}$ ( $\text{m}^{-1}$ )	$\frac{z}{L}$	$\psi(\frac{z}{L})$	$\frac{1}{k} [\ln(\frac{z}{z_0}) - \psi(\frac{z}{L})]$
A	-0.08	-0.8	0.98	5.0
B	-0.04	-0.4	0.68	5.8
C	-0.01	-0.1	0.27	6.8
D	0.00	0.0	0.00	7.5
E	0.01	0.1	-0.47	8.7
F	0.05	0.5	-2.35	13.4

TABLE 15. Computed estimates of the mean friction velocity  $u_*$  in meters per second as a function of wind speed and Pasquill category.  $u_m$  is a mean speed for  $V < 12$  (see text).

WIND SPEED (KNOTS)	$u_m$ (m/s)	PASQUILL CATEGORY					
		A	B	C	D	E	F
$0 \leq V < 2$	.50	0.10	0.09	0.07	0.07		0.04
$2 \leq V < 4$	1.55	0.31	0.27	0.23	0.21		0.12
$4 \leq V < 6$	2.55	0.51	0.44	0.38	0.34	0.29	0.19
$6 \leq V < 7$	3.35		0.58	0.49	0.45	0.39	0.25
$7 \leq V < 8$	3.90		0.67	0.57	0.52	0.45	
$8 \leq V < 10$	4.65		0.80	0.68	0.62	0.53	
$10 \leq V < 11$	5.40			0.79	0.72	0.62	
$11 \leq V < 12$	5.90			0.87	0.79		
$12 \leq V$	7.00			1.03	0.93		
	8.00			1.18	1.07		

TABLE 16. Percentage frequency of  $\sigma_u$  at Frankfurt as a function of time and season.

GMT	STANDARD DEVIATION CATEGORY (m/s)	SEASON			
		WINTER	SPRING	SUMMER	FALL
0000	$0 \leq \sigma_u < 0.5$	54.8	55.6	72.7	63.4
	$0.5 \leq \sigma_u < 1.0$	17.5	16.2	9.0	13.1
	$1.0 \leq \sigma_u < 1.5$	16.2	19.1	14.6	13.5
	$1.5 \leq \sigma_u < 2.0$	7.0	5.5	3.0	5.8
	$2.0 \leq \sigma_u$	4.6	3.7	0.7	4.2
0600	$0 \leq \sigma_u < 0.5$	57.6	22.0	21.7	48.2
	$0.5 \leq \sigma_u < 1.0$	14.3	34.5	25.2	26.6
	$1.0 \leq \sigma_u < 1.5$	15.6	26.3	32.8	15.5
	$1.5 \leq \sigma_u < 2.0$	7.3	13.6	18.6	6.3
	$2.0 \leq \sigma_u$	5.2	3.6	1.8	3.4
1200	$0 \leq \sigma_u < 0.5$	13.9	6.6	6.4	13.0
	$0.5 \leq \sigma_u < 1.0$	19.0	13.0	6.6	15.8
	$1.0 \leq \sigma_u < 1.5$	29.4	5.2	6.6	17.5
	$1.5 \leq \sigma_u < 2.0$	29.7	38.1	23.0	36.3
	$2.0 \leq \sigma_u$	8.0	37.1	57.4	17.5
1800	$0 \leq \sigma_u < 0.5$	54.4	29.0	12.8	60.7
	$0.5 \leq \sigma_u < 1.0$	15.2	30.8	51.1	11.1
	$1.0 \leq \sigma_u < 1.5$	16.4	23.8	25.6	14.6
	$1.5 \leq \sigma_u < 2.0$	8.9	11.4	7.5	8.7
	$2.0 \leq \sigma_u$	5.2	5.0	3.1	4.9

TABLE 17. Percentage frequency of  $\sigma_u$  at Hahn as a function of time and season.

GMT	STANDARD DEVIATION CATEGORY (m/s)	SEASON			
		WINTER	SPRING	SUMMER	FALL
0000	$0 \leq \sigma_u < 0.5$	31.4	58.9	79.1	56.5
	$0.5 \leq \sigma_u < 1.0$	20.4	17.3	9.3	14.9
	$1.0 \leq \sigma_u < 1.5$	28.0	16.7	9.3	17.3
	$1.5 \leq \sigma_u < 2.0$	12.7	4.8	1.8	6.9
	$2.0 \leq \sigma_u$	7.4	2.4	0.6	4.3
0600	$0 \leq \sigma_u < 0.5$	31.7	20.1	14.6	38.9
	$0.5 \leq \sigma_u < 1.0$	17.4	31.2	35.4	26.6
	$1.0 \leq \sigma_u < 1.5$	27.7	31.1	31.2	20.9
	$1.5 \leq \sigma_u < 2.0$	15.4	14.0	16.9	8.4
	$2.0 \leq \sigma_u$	7.9	3.6	1.9	5.2
1200	$0 \leq \sigma_u < 0.5$	6.5	6.9	6.1	7.2
	$0.5 \leq \sigma_u < 1.0$	13.2	11.2	7.1	16.0
	$1.0 \leq \sigma_u < 1.5$	23.7	6.6	9.6	18.6
	$1.5 \leq \sigma_u < 2.0$	41.7	39.5	19.7	42.2
	$2.0 \leq \sigma_u$	14.8	35.8	57.5	16.0
1800	$0 \leq \sigma_u < 0.5$	35.2	29.7	12.0	53.1
	$0.5 \leq \sigma_u < 1.0$	17.8	37.4	59.6	15.6
	$1.0 \leq \sigma_u < 1.5$	24.1	22.8	23.1	18.3
	$1.5 \leq \sigma_u < 2.0$	14.8	6.6	4.2	8.0
	$2.0 \leq \sigma_u$	8.1	3.5	1.1	5.1

TABLE 18. Percentage frequency of  $\sigma_u$  at Osan as a function of time and season.

LOCAL TIME	STANDARD DEVIATION CATEGORY (m/s)	SEASON			
		WINTER	SPRING	SUMMER	FALL
0000	$0 \leq \sigma_u < 0.5$	89.6	90.7	92.1	92.4
	$0.5 \leq \sigma_u < 1.0$	4.9	4.3	4.3	3.7
	$1.0 \leq \sigma_u < 1.5$	4.1	3.3	2.7	2.4
	$1.5 \leq \sigma_u < 2.0$	1.2	1.2	0.6	1.0
	$2.0 \leq \sigma_u$	0.2	0.5	0.3	0.6
0600	$0 \leq \sigma_u < 0.5$	91.7	62.9	63.1	86.8
	$0.5 \leq \sigma_u < 1.0$	4.8	29.6	25.3	9.7
	$1.0 \leq \sigma_u < 1.5$	2.3	4.8	8.7	2.9
	$1.5 \leq \sigma_u < 2.0$	0.8	2.0	2.4	0.3
	$2.0 \leq \sigma_u$	0.3	0.7	0.5	0.3
1200	$0 \leq \sigma_u < 0.5$	29.5	19.2	23.2	29.0
	$0.5 \leq \sigma_u < 1.0$	20.3	8.8	1.0	23.5
	$1.0 \leq \sigma_u < 1.5$	15.8	13.0	25.9	7.1
	$1.5 \leq \sigma_u < 2.0$	24.9	18.1	1.6	25.2
	$2.0 \leq \sigma_u$	9.4	40.9	48.3	15.1
1800	$0 \leq \sigma_u < 0.5$	86.9	42.9	33.3	91.7
	$0.5 \leq \sigma_u < 1.0$	5.8	36.5	54.9	3.2
	$1.0 \leq \sigma_u < 1.5$	4.8	15.2	10.4	4.1
	$1.5 \leq \sigma_u < 2.0$	1.7	3.8	1.0	0.3
	$2.0 \leq \sigma_u$	0.8	1.6	0.5	0.6

TABLE 19. Annual percentage of standard deviations in each class estimated from Pasquill and wind data recorded by Reiquam (1980).

STANDARD DEVIATION (meters per second)	WYOMING		NEW MEXICO	
	Moorcroft	Project Site	Farmington	Project Site
$0 \leq \sigma_u < 0.5$	34.3	20.5	38.5	24.3
$0.5 \leq \sigma_u < 1.0$	24.6	37.3	33.4	41.9
$1.0 \leq \sigma_u < 1.5$	18.9	19.1	16.2	16.0
$1.5 \leq \sigma_u < 2.0$	10.3	9.8	5.6	8.1
$2.0 \leq \sigma_u$	11.9	13.3	6.3	9.7

## APPENDIX

### WIND SPEED DISTRIBUTIONS

In order to understand the relationship between turbulence, Pasquill index and wind speed, it may be of interest to provide a survey on wind speed distributions for a selected number of stations in the Northern Hemisphere.

The data in Tables A1-A12 were obtained from surface winds recorded as the lowest level of radiosonde ascents. These surface winds were observed by customary measurements with standard anemometers at each site. The standard height of an anemometer is 10 m above the ground (Haynes, 1958, see p. 120). All data have been checked according to a procedure outlined by Essenwanger (1970) to assure good quality.

For many problems of the practitioner the higher probability thresholds are particularly important, and therefore the following thresholds of the cumulative frequency are included in Tables A1-A12: 50.0, 84.1, 90.0, 95.0, 97.7, and 99.0 percent. These tables also contain means, maxima, standard deviations, and numbers of observations. The standard deviations listed in Tables A1-A12 are computed from the observations and should not be confused with the standard deviations of turbulent fluctuations which are discussed in previous sections. The station locations, elevations, and periods of records are listed in Table A13.

The station called Osan-Ni here is the same station referred to as Osan, Korea, in Sections II and IV. The frequency distributions for Osan-Ni in Tables A1-A12 are for the period April 1957-April 1963. The wind data for Osan in the earlier sections are for the period January 1973-December 1979. The wind speeds are lower during the later period. This is probably an effect of urbanization. Empirical evidence cited by Landsberg (1981) shows that wind speeds become lower as a city grows. Landsberg illustrates that the mean wind speed decreased by 40 percent from 1945 to 1970 at one location. Korea has indeed been industrializing rapidly (Young, 1982), and in recent years a considerable shift from the country to metropolitan areas has been observed. Young estimates that one-half of the Koreans now live in urban areas.

As expected and known from the literature (Stewart and Essenwanger, 1978), the frequency distributions are typically asymmetrical and skewed to the right in all seasons at most stations. The annual average mean of all stations is 10 percent greater than the annual average median, and the monthly variation of the ratio of the two quantities is small. The mean wind speeds are largest in winter and smallest in summer. Most of the frequency distributions are consistent with Hennessey's (1977) suggestion that the ratio of the standard deviation to the mean should be between 0.4 and 1.0. A discussion of parameterization of wind frequency distributions is found in Stewart and Essenwanger (1978).

TABLE A1. Cumulative distributions of wind speed (m/s) for January.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	6.6	6.2	11.0	12.5	14.3	15.4	16.2	17	4.2	155	
Albrook	4.3	4.2	6.5	7.2	8.3	9.1	9.9	15	2.1	425	
Albuquerque	3.4	2.9	5.3	6.7	8.2	9.3	10.7	12	2.1	493	
Alert	3.4	2.0	7.3	9.8	11.7	19.8	21.1	23	4.5	155	
Anchorage	2.8	2.6	4.8	5.4	7.0	8.4	9.4	11	2.0	490	
Bahrein	4.9	4.6	8.4	9.1	10.3	11.4	12.5	13	3.1	155	
Barrow	5.6	4.9	8.7	9.9	12.3	14.3	15.4	19	3.2	474	
Barter Island	7.0	5.6	11.3	13.4	15.7	20.6	24.2	26	4.7	469	
Berlin	4.4	4.2	6.8	7.4	8.7	9.7	11.3	12	2.2	124	
Chateauroux	4.7	4.3	7.5	8.9	10.9	14.0	16.2	18	3.1	367	
Churchill	7.9	7.7	11.7	13.3	15.5	17.6	19.1	26	4.0	461	
El Paso	4.6	4.0	7.5	8.9	10.5	11.5	14.7	21	3.0	484	
International Falls	4.1	4.0	6.1	7.1	8.4	9.2	10.2	18	2.2	556	
Kadena	5.4	4.9	8.8	9.5	11.0	12.4	13.2	18	3.0	576	
Kagoshima	3.6	3.2	5.6	6.6	7.4	9.2	12.4	14	2.2	155	
Keflavik	8.4	7.4	13.7	15.3	18.7	20.8	23.9	29	5.3	979	
Kwajalein	8.7	9.0	10.9	11.2	11.9	12.2	12.5	13	2.0	322	
Miami	3.7	3.4	5.6	6.8	8.0	9.0	9.4	11	2.0	492	
Montgomery	3.7	3.3	5.8	6.9	8.2	9.3	10.5	12	2.2	553	

TABLE A1(Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Moscow	3.5	3.1	5.8	6.7	7.5	9.9	11.1	12	2.3	186	
Munich	3.7	3.0	6.9	8.5	10.1	12.1	13.2	18	3.0	310	
New York	5.5	5.3	9.4	10.7	12.0	13.0	13.5	18	3.1	432	
Norfolk	5.4	4.9	8.8	9.6	11.1	12.5	13.7	18	3.0	558	
Osan-Ni	3.1	2.8	6.0	7.1	8.5	9.4	10.9	15	2.7	735	
Peoria	4.9	4.7	7.2	7.9	9.0	9.7	10.8	13	2.1	552	
San Juan	3.5	3.5	5.5	6.4	7.3	8.3	9.0	10	2.1	447	
Shemya	9.6	9.6	13.8	14.8	16.2	18.3	21.5	23	4.3	296	
Stephenville	6.4	5.6	10.0	11.1	13.3	16.7	18.8	24	4.0	978	
Swan Island	5.6	5.1	8.0	8.8	9.5	10.7	11.4	13	2.1	421	
Tatoosh Island	9.0	8.3	14.1	16.1	18.8	21.0	22.6	25	5.0	553	
Thule	3.0	2.5	5.0	6.9	9.2	10.9	12.5	25	2.9	955	
Tripoli	5.1	4.3	7.8	9.1	11.7	13.4	16.0	22	3.3	426	
Washington, D.C.	4.0	3.7	6.7	8.0	9.1	10.5	11.9	18	2.8	701	
Wiesbaden	4.2	3.8	7.8	9.0	10.5	12.1	13.2	17	3.3	418	
Zhana/Semey	3.9	3.2	7.1	9.2	11.6	13.1	16.8	18	3.5	137	

TABLE A2. Cumulative distributions of wind speed (m/s) for February.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	5.3	4.6	8.6	9.5	12.5	14.1	15.4	16	3.4	142	
Albrook	5.0	4.7	7.4	8.5	9.6	10.9	11.6	21	2.5	390	
Albuquerque	4.2	3.3	7.5	8.9	10.4	11.4	13.3	18	2.9	448	
Alert	3.8	2.0	8.0	12.0	16.5	22.3	24.7	29	5.6	141	
Anchorage	3.0	2.7	5.1	5.9	7.4	9.2	12.1	18	2.4	448	
Bahrein	5.0	4.7	8.4	9.5	10.7	11.3	12.1	13	3.0	142	
Barrow	5.1	4.4	8.3	9.4	11.3	13.1	14.8	20	3.0	435	
Barter Island	6.5	5.4	9.9	11.9	17.1	19.3	22.7	25	4.4	444	
Berlin	4.2	4.0	6.3	7.2	8.8	10.4	11.3	13	2.2	142	
Chateauroux	4.6	4.0	7.5	9.2	11.6	14.4	16.6	18	3.4	390	
Churchill	7.9	7.6	11.4	12.9	15.2	18.1	19.2	21	3.7	433	
El Paso	5.3	4.6	8.7	10.0	12.6	14.6	16.6	22	3.6	447	
International Falls	3.9	3.8	5.8	7.1	8.5	9.3	10.6	13	2.3	510	
Kadena	4.8	4.5	7.9	8.8	9.7	11.0	12.1	14	2.6	509	
Kagoshima	3.4	3.0	5.2	6.1	7.5	9.0	10.1	11	2.0	142	
Keflavik	8.1	7.2	13.5	15.2	18.2	20.9	22.9	30	5.2	883	
Kwajalein	9.0	9.1	11.2	11.8	12.7	13.1	13.5	14	2.2	310	
Miami	4.3	4.0	6.4	7.4	8.5	9.2	9.5	13	2.0	449	
Montgomery	4.1	3.9	6.2	7.2	8.5	9.4	10.6	13	2.2	508	

TABLE A2 (Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Moscow	3.8	3.5	6.3	7.0	7.8	10.1	11.1	12	2.5	170	
Munich	3.5	2.8	6.2	8.0	9.7	11.2	13.7	16	3.0	281	
New York	6.0	5.0	9.5	10.7	12.5	14.2	15.3	31	3.4	394	
Norfolk	5.6	5.3	8.7	9.3	10.9	12.7	14.3	18	2.9	395	
Osan-Ni	3.1	2.6	6.1	7.3	9.1	10.8	12.6	15	2.9	672	
Peoria	5.2	4.9	7.6	8.7	9.6	10.8	11.4	13	2.2	497	
San Juan	3.5	3.4	5.5	6.3	7.4	8.0	8.5	9	2.0	422	
Shemya	9.3	9.2	13.9	15.1	17.5	19.3	21.1	23	4.5	263	
Stephenville	5.8	4.9	10.0	11.5	13.4	18.4	21.1	27	4.6	895	
Swan Island	5.9	5.4	8.5	9.1	10.0	11.1	12.1	15	2.2	377	
Tatoosh Island	8.2	7.6	12.9	14.3	16.7	18.7	20.5	28	4.5	501	
Thule	2.7	2.3	4.4	5.7	9.0	11.2	12.9	28	2.9	883	
Tripoli	4.4	3.8	7.0	8.7	10.9	13.0	15.9	21	3.2	380	
Washington, D.C.	4.0	3.6	6.9	8.2	9.3	11.0	12.6	16	2.8	621	
Wiesbaden	3.9	3.6	6.8	8.0	9.2	11.5	13.2	15	3.0	394	
Zhana/Semey	2.9	2.2	5.1	7.0	9.4	11.8	12.2	12	2.9	124	

TABLE A3. Cumulative distributions of wind speed (m/s) for March.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	4.8	4.0	8.7	9.6	11.3	13.2	15.0	17	3.4	155	
Albrook	4.8	4.4	7.4	8.6	10.6	11.6	12.4	13	2.6	433	
Albuquerque	4.7	3.8	8.3	9.4	11.1	12.9	14.3	15	3.1	498	
Alert	2.3	1.4	4.1	5.3	11.3	15.0	18.4	25	3.9	155	
Anchorage	3.4	3.1	5.5	6.8	8.4	10.0	11.2	14	2.4	487	
Bahrein	4.7	4.2	7.8	9.6	11.2	12.7	14.4	17	3.3	155	
Barrow	5.4	4.8	8.4	9.4	11.0	12.7	14.6	25	3.0	482	
Barter Island	6.8	5.9	10.5	12.3	15.0	18.4	19.7	29	4.2	476	
Berlin	4.4	4.2	6.2	6.9	7.6	10.0	12.4	14	2.1	155	
Chateauroux	4.2	3.7	6.5	7.5	9.1	11.3	13.4	15	2.6	423	
Churchill	7.1	6.8	10.4	11.7	13.6	15.2	18.7	25	3.6	478	
El Paso	5.7	4.9	9.3	10.7	13.2	14.8	15.6	18	3.6	493	
International Falls	4.1	3.9	6.2	7.3	8.6	9.4	11.0	17	2.3	558	
Kadena	4.5	4.1	7.5	8.4	9.3	10.3	11.1	13	2.5	547	
Kagoshima	3.2	2.8	5.3	6.5	8.0	8.8	9.4	10	2.1	154	
Keflavik	8.1	7.5	12.9	14.4	16.9	18.9	20.2	26	4.5	982	
Kwajalein	8.2	8.3	10.4	10.9	11.4	12.5	13.3	18	2.1	408	
Miami	4.3	4.1	6.5	7.3	8.4	9.1	9.6	13	2.0	489	
Montgomery	4.1	4.0	6.6	7.4	8.7	9.8	11.0	17	2.4	582	

TABLE A3 (Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Moscow	3.3	2.8	5.9	7.2	9.9	11.0	11.8	15	2.9	186	
Munich	3.3	2.7	5.3	6.6	8.7	11.5	15.5	26	3.2	310	
New York	6.4	5.5	9.7	11.0	12.5	13.4	14.5	21	3.1	433	
Norfolk	5.7	5.3	8.7	9.3	10.7	12.6	14.3	35	3.0	556	
Osan-Ni	3.5	3.0	6.5	7.6	9.1	11.0	13.4	16	3.0	721	
Peoria	5.6	5.2	8.1	8.9	9.6	11.4	13.1	19	2.4	566	
San Juan	3.4	3.4	5.3	6.0	6.9	7.3	8.1	9	1.8	429	
Shemya	9.6	9.4	14.1	15.5	18.3	19.9	21.0	23	4.4	292	
Stephenville	5.2	4.6	8.9	10.4	12.4	15.7	17.4	22	3.9	958	
Swan Island	6.0	5.5	8.7	9.2	10.3	11.2	12.4	15	2.3	415	
Tatoosh Island	7.7	7.2	11.8	13.2	15.1	17.6	19.4	21	4.1	546	
Thule	2.2	2.1	3.4	4.4	5.5	8.5	10.2	13	2.0	963	
Tripoli	4.7	4.0	7.3	8.8	10.8	12.7	14.4	22	3.0	420	
Washington, D.C.	3.9	3.8	6.5	7.5	8.7	9.4	10.7	13	2.5	656	
Wiesbaden	4.1	3.7	7.5	8.5	9.4	11.0	13.3	15	3.1	427	
Zhana/Semey	2.8	1.8	5.9	7.3	11.2	14.2	15.3	16	3.5	130	

TABLE A4. Cumulative distributions of wind speed (m/s) for April.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	4.9	3.5	9.2	10.6	13.0	14.4	15.4	16	3.9	150	
Albrook	4.4	4.2	7.0	7.9	9.3	10.6	11.3	13	2.6	406	
Albuquerque	5.3	4.3	8.8	10.2	12.5	14.3	15.2	18	3.4	482	
Alert	2.2	1.3	4.5	7.5	12.5	15.2	17.3	18	3.7	150	
Anchorage	3.2	3.0	5.1	5.7	7.1	8.4	9.4	27	2.2	476	
Bahrein	4.2	3.5	7.2	9.3	11.6	12.8	13.4	14	3.2	150	
Barrow	5.6	5.0	8.6	9.4	11.1	12.5	13.4	19	2.8	475	
Barter Island	5.7	5.1	9.1	10.6	12.9	14.7	15.8	21	3.5	474	
Berlin	3.7	3.6	5.4	6.3	7.2	8.1	8.9	9	1.7	150	
Chateauroux	4.3	4.0	6.9	7.9	9.1	10.3	11.3	12	2.5	404	
Churchill	7.7	7.6	11.5	12.8	14.7	17.4	18.8	24	3.9	461	
El Paso	6.0	5.1	9.5	10.8	12.6	14.9	18.6	23	3.7	474	
International Falls	4.7	4.5	7.4	8.3	9.1	9.5	11.0	13	2.3	533	
Kadena	4.6	4.3	7.2	8.1	9.0	9.9	11.3	13	2.4	525	
Kagoshima	3.6	3.2	6.0	7.1	8.7	10.3	11.3	12	2.3	148	
Keflavik	7.4	6.7	11.5	13.3	15.1	17.9	20.1	27	4.2	953	
Kwajalein	8.7	8.8	10.9	11.3	12.1	12.9	13.3	14	2.1	455	
Miami	4.5	4.3	6.7	7.3	8.5	9.3	11.1	15	2.1	480	
Montgomery	3.5	3.2	5.4	6.7	8.2	9.4	10.7	15	2.3	554	

TABLE A4 (Continued)

STATION	MEAN	50.00	84.10	90.00	95.00	97.72	99.00	MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
Moscow	2.3	2.0	4.6	5.4	6.6	7.2	9.9	10	2.0	180
Munich	3.5	3.0	6.1	7.2	8.5	9.3	10.5	13	2.4	300
New York	6.0	5.7	9.1	10.0	11.2	12.4	13.3	15	2.8	417
Norfolk	5.7	5.3	8.6	9.3	11.1	12.7	13.7	15	2.8	536
Osan-Ni	3.0	2.6	5.9	7.2	8.7	10.0	11.5	14	2.8	806
Peoria	5.6	5.3	8.4	9.1	10.1	11.1	12.1	14	2.4	528
San Juan	3.4	3.3	5.4	6.3	7.4	8.0	8.4	9	2.1	417
Shemya	8.8	8.5	12.5	13.8	16.0	18.4	19.1	21	3.8	296
Stephenville	4.7	4.3	8.0	9.2	11.3	13.2	16.1	23	3.6	929
Swan Island	5.7	5.2	8.1	8.8	9.7	10.1	10.5	11	1.9	414
Tatoosh Island	6.5	5.7	10.5	12.1	14.1	16.9	19.4	28	4.0	537
Thule	2.2	1.9	3.9	5.1	7.4	9.9	11.7	18	2.5	915
Tripoli	4.7	4.3	7.4	8.5	9.4	10.9	12.3	15	2.6	408
Washington, D.C.	3.8	3.8	6.1	7.0	8.1	9.2	10.2	18	2.4	644
Wiesbaden	3.9	3.9	6.6	7.5	8.8	9.4	11.4	13	2.7	418
Zhana/Semey	2.3	1.7	4.8	5.9	7.2	8.7	11.8	12	2.5	137

TABLE A5. Cumulative distributions of wind speed (m/s) for May.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	3.6	2.9	6.0	7.4	10.5	12.1	13.4	14	2.8	155	
Albrook	3.3	3.2	5.4	6.3	7.2	8.1	9.1	13	2.2	432	
Albuquerque	4.9	4.0	8.5	9.3	10.6	11.6	13.2	17	2.9	505	
Alert	2.6	2.0	4.8	6.8	10.3	14.0	16.4	20	3.5	155	
Anchorage	4.0	3.9	6.4	7.3	8.6	9.4	10.7	12	2.2	434	
Bahrein	4.8	4.4	8.7	9.8	12.1	13.4	14.4	15	3.5	155	
Barrow	5.8	5.3	8.7	9.5	11.1	12.3	13.0	15	2.6	425	
Barter Island	6.2	5.6	9.0	10.4	13.7	15.1	18.3	25	3.5	431	
Berlin	3.7	3.5	5.5	6.6	7.6	8.6	9.0	9	1.8	155	
Chateauroux	3.5	3.3	5.5	6.5	7.4	9.0	10.9	15	2.2	424	
Churchill	7.5	7.1	11.3	12.9	15.0	17.4	19.5	31	4.1	408	
El Paso	5.1	4.5	8.5	9.6	11.2	13.2	14.6	20	3.2	508	
International Falls	4.5	4.3	6.8	7.8	9.1	10.5	11.7	15	2.4	558	
Kadena	4.3	4.1	6.7	7.3	8.3	9.1	9.7	15	2.2	559	
Kagoshima	3.3	3.0	5.3	6.4	8.0	8.8	9.4	10	2.2	155	
Keflavik	6.7	6.0	11.0	12.4	14.2	16.8	19.0	25	4.0	974	
Kwajalein	8.2	8.4	10.6	11.1	11.8	12.8	13.3	14	2.2	464	
Miami	4.1	3.9	6.0	6.9	7.8	8.8	9.3	10	1.9	517	
Montgomery	2.9	2.8	4.8	5.2	6.0	7.1	8.4	15	1.9	565	

TABLE A5 (Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Moscow	2.1	1.7	4.3	5.2	6.4	7.2	7.6	8	2.1	186	
Munich	3.1	2.8	5.0	5.6	7.3	8.9	10.0	11	2.0	309	
New York	5.1	4.7	8.0	8.9	9.8	10.8	11.3	13	2.3	436	
Norfolk	4.6	4.5	7.3	8.2	9.0	9.5	10.9	13	2.3	556	
Osan-Ni	2.7	2.5	5.1	6.0	7.6	9.2	11.4	14	2.5	739	
Peoria	5.0	4.8	7.3	8.2	9.1	10.0	11.1	14	2.1	588	
San Juan	3.2	3.2	5.4	6.3	7.4	8.0	8.4	9	2.2	368	
Shemya	8.4	8.3	11.2	12.6	14.4	15.5	17.5	21	3.3	306	
Stephenville	4.1	3.8	7.0	7.9	9.3	10.9	12.8	22	3.1	951	
Swan Island	5.1	4.9	7.0	7.5	8.5	9.1	9.3	10	1.7	426	
Tatoosh Island	5.6	5.0	8.7	9.7	11.5	13.0	14.5	19	3.0	556	
Thule	2.6	2.3	4.6	5.7	7.7	9.9	11.6	17	2.5	978	
Tripoli	4.0	3.8	6.3	7.2	8.6	9.6	11.4	13	2.3	422	
Washington, D.C.	3.2	3.2	5.1	5.5	6.7	7.4	8.8	10	2.0	683	
Wiesbaden	3.6	3.4	6.4	7.8	9.3	10.7	12.3	18	3.0	433	
Zhanna/Semey	2.1	1.2	4.6	5.3	6.8	8.6	13.0	13	2.5	126	

TABLE A6. Cumulative distributions of wind speed (m./s.) for June.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	2.9	2.4	5.3	6.3	7.2	8.6	10.5	16	2.4	150	
Albrook	2.6	2.4	4.8	5.4	6.9	8.2	9.3	10	2.2	418	
Albuquerque	4.4	3.5	7.6	8.7	9.6	10.9	11.6	14	2.6	486	
Alert	3.3	2.5	5.3	8.7	11.6	13.2	14.4	15	3.4	149	
Anchorage	3.7	3.6	5.5	6.6	7.7	8.7	9.1	9	2.0	420	
Bahrein	4.7	4.0	8.2	9.0	10.8	11.7	12.4	13	3.1	150	
Barrow	5.3	4.9	7.8	8.6	9.4	10.7	11.5	18	2.2	414	
Barter Island	5.1	4.8	7.9	8.7	9.3	10.3	11.3	18	2.5	419	
Berlin	3.8	3.5	5.9	6.7	7.3	8.3	9.3	11	1.9	150	
Chateauroux	3.2	3.0	5.1	5.6	7.3	8.8	9.8	17	2.2	348	
Churchill	6.4	6.1	9.9	11.1	12.8	13.7	14.4	15	3.3	398	
El Paso	4.7	4.2	7.4	8.7	10.1	11.3	13.0	18	2.7	421	
International Falls	3.7	3.6	5.4	6.3	7.5	8.7	9.3	18	2.1	480	
Kadena	4.6	4.4	7.0	7.8	9.0	10.2	12.5	15	2.4	542	
Kagoshima	3.1	2.7	5.2	6.2	7.8	10.7	14.5	16	2.6	150	
Keflavik	5.9	5.2	9.3	10.9	13.3	15.0	17.1	20	3.7	946	
Kwajalein	7.3	7.2	9.9	10.7	11.4	12.6	13.4	20	2.5	460	
Miami	3.3	3.1	5.0	5.4	6.5	7.5	8.9	11	1.6	418	
Montgomery	3.1	2.9	4.9	5.3	6.6	8.0	9.2	12	1.9	596	

TABLE A6 (Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)						MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00			
Moscow	2.0	1.5	3.8	4.7	5.5	6.9	7.9	11	2.0	180
Munich	3.1	2.8	5.0	5.6	6.9	8.0	9.5	13	1.9	300
New York	5.0	4.5	8.0	8.9	9.7	11.1	12.1	13	2.5	424
Norfolk	4.2	4.0	6.7	7.6	8.8	9.4	10.5	14	2.2	540
Osan-Ni	2.4	2.2	4.7	5.3	6.7	8.1	10.3	19	2.4	708
Peoria	4.3	4.3	6.3	6.9	7.5	8.6	9.1	10	1.8	503
San Juan	3.4	3.3	5.3	5.9	7.1	8.1	9.0	10	2.0	359
Shemya	6.8	6.7	9.9	10.9	12.5	14.3	16.2	18	3.2	302
Stephenville	3.6	3.3	6.4	7.3	8.6	9.4	11.7	18	2.8	954
Swan Island	5.8	5.6	8.1	8.8	9.6	10.1	10.5	11	2.0	418
Tatoosh Island	5.0	4.7	7.2	8.1	9.3	11.2	13.6	21	2.5	475
Thule	2.5	2.3	4.1	5.3	7.1	9.1	11.0	13	2.2	952
Tripoli	4.3	4.0	6.7	7.8	9.3	11.2	12.6	18	2.6	415
Washington, D.C.	2.8	2.7	4.8	5.2	5.6	7.2	8.9	13	1.9	601
Wiesbaden	3.1	2.7	5.7	6.9	8.3	9.0	11.1	13	2.7	418
Zhana/Semey	1.4	0.5	3.4	4.4	5.3	8.5	12.9	14	2.3	130

TABLE A7. Cumulative distributions of wind speed (m/s) for July.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	2.7	2.2	5.5	6.5	7.5	7.9	8.5	9	2.3	155	
Albrook	2.9	2.8	4.8	5.2	5.9	7.2	8.3	9	1.9	424	
Albuquerque	4.4	3.7	7.4	8.6	10.5	11.6	12.4	13	2.6	430	
Alert	3.4	2.2	6.3	10.1	13.8	15.8	17.3	18	4.1	155	
Anchorage	3.4	3.2	5.3	6.2	7.5	8.8	9.5	11	2.0	432	
Bahrein	3.8	3.6	6.5	7.4	8.5	9.1	9.4	15	2.6	155	
Barrow	5.3	4.9	7.7	8.6	9.4	10.7	11.5	13	2.3	393	
Barter Island	4.9	4.6	7.3	8.5	9.8	11.0	12.0	15	2.5	421	
Berlin	3.4	3.1	5.5	6.5	7.5	8.8	9.4	10	2.0	124	
Chateauroux	3.5	3.0	5.5	6.7	8.1	10.1	12.3	18	2.5	378	
Churchill	6.5	6.0	9.8	11.6	13.3	15.0	18.4	21	3.6	370	
El Paso	4.6	4.3	7.2	8.4	9.8	10.9	11.4	12	2.5	432	
International Falls	3.4	3.3	5.2	5.7	7.5	8.9	9.9	11	2.0	493	
Kadena	4.8	4.2	7.9	9.1	10.7	12.6	14.3	22	3.0	461	
Kagoshima	2.9	2.7	5.1	5.8	7.4	8.7	9.3	10	2.1	155	
Keflavik	5.4	4.9	8.6	9.8	11.2	12.9	14.3	18	3.1	981	
Kwajalein	5.5	5.4	8.4	9.0	9.7	10.8	11.3	14	2.5	506	
Miami	3.1	3.0	5.0	5.4	6.4	7.0	7.5	8	1.6	433	
Montgomery	2.9	2.8	4.7	5.2	5.9	7.0	7.9	15	1.8	618	

TABLE A7 (Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Moscow	1.8	1.6	3.3	3.8	4.7	5.3	5.6	7	1.5	186	
Munich	3.3	2.9	5.4	6.4	7.9	8.8	9.4	10	2.1	309	
New York	4.9	4.5	7.7	8.6	9.3	10.4	11.2	15	2.3	433	
Norfolk	4.0	3.8	5.9	6.9	7.9	9.0	9.5	14	2.0	555	
Osan-Ni	2.6	2.4	4.9	5.7	7.2	8.7	9.7	13	2.4	731	
Peoria	4.0	4.0	5.5	6.4	7.4	8.7	9.5	11	1.8	502	
San Juan	3.7	3.7	5.4	6.3	7.4	8.0	8.4	9	2.0	362	
Shemya	5.8	5.3	8.9	9.8	11.0	12.1	13.4	18	2.8	349	
Stephenville	3.4	3.1	6.0	7.0	8.5	10.0	11.3	14	2.7	983	
Swan Island	5.2	5.0	7.0	7.4	8.5	9.1	9.4	10	1.6	429	
Tatoosh Island	5.2	4.9	7.7	8.7	9.9	11.3	12.4	13	2.5	492	
Thule	2.7	2.2	4.7	6.5	9.0	11.2	12.7	18	2.7	978	
Tripoli	3.6	3.6	5.5	6.5	7.3	8.5	9.2	10	2.1	426	
Washington, D.C.	2.6	2.5	4.7	5.1	5.5	6.6	7.2	10	1.8	619	
Wiesbaden	3.0	2.7	6.1	7.1	8.5	9.4	10.6	12	2.8	408	
Zhanna/Semey	1.4	0.5	3.3	4.3	5.2	7.3	9.1	10	2.0	139	

TABLE A8. Cumulative distributions of wind speed (m/s) for August.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	2.7	2.0	5.2	6.8	8.7	10.2	11.2	14	2.7	155	
Albrook	3.0	3.0	5.0	5.4	6.5	7.0	7.5	8	1.8	367	
Albuquerque	3.7	3.2	5.5	6.8	8.2	8.9	9.4	10	2.0	432	
Alert	2.7	2.2	4.9	6.8	9.1	12.0	14.4	16	3.0	155	
Anchorage	3.0	2.8	5.0	5.6	6.9	7.8	9.2	11	1.9	434	
Bahrein	3.0	2.9	5.1	5.5	7.3	10.2	11.2	12	2.5	155	
Barrow	6.0	5.3	8.9	9.7	11.2	12.6	13.5	15	2.7	418	
Barter Island	5.6	4.9	8.7	9.9	12.0	14.1	17.3	18	3.2	432	
Berlin	3.6	3.4	5.5	6.4	7.2	8.1	8.9	9	1.8	155	
Chateauroux	3.8	3.4	6.2	7.1	8.6	10.6	12.6	15	2.6	426	
Churchill	6.9	6.2	10.8	12.2	14.0	15.4	17.1	18	3.7	413	
El Paso	4.3	4.0	6.8	7.6	8.8	9.5	10.9	15	2.3	431	
International Falls	3.6	3.5	5.4	6.2	7.3	8.6	9.3	12	2.1	492	
Kadena	4.8	4.0	8.3	9.5	12.0	14.6	18.9	23	3.7	463	
Kagoshima	4.2	3.0	7.2	9.7	13.0	18.0	20.0	21	4.1	155	
Keflavik	5.4	4.9	9.0	10.2	11.5	13.0	14.1	21	3.3	986	
Kwajalein	4.9	4.7	7.2	8.1	9.3	9.9	10.4	11	2.2	393	
Miami	3.0	2.8	4.8	5.2	5.8	6.8	7.3	8	1.5	436	
Montgomery	2.8	2.8	4.6	5.1	5.5	7.0	8.2	12	1.7	620	

TABLE A8 (Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Moscow	1.8	1.5	3.4	4.2	5.0	5.5	6.9	8	1.7	185	
Munich	3.3	2.9	5.1	6.4	8.7	10.3	12.1	15	2.4	309	
New York	4.6	4.3	6.9	7.6	8.8	9.5	11.1	18	2.2	434	
Norfolk	3.9	3.6	6.2	7.2	8.5	9.4	14.0	20	2.5	555	
Osan-Ni	2.7	2.5	5.1	6.0	7.2	9.0	10.8	16	2.4	733	
Peoria	3.8	3.7	5.3	5.9	7.1	8.1	9.0	10	1.6	506	
San Juan	3.4	3.4	5.3	5.9	7.2	7.9	8.4	9	2.1	369	
Shemya	6.3	5.7	9.2	10.3	11.6	13.2	18.1	20	3.1	271	
Stephenville	3.8	3.4	6.6	7.7	9.2	10.7	11.6	18	2.9	982	
Swan Island	4.7	4.6	6.4	7.0	7.5	8.6	9.2	10	1.5	428	
Tatoosh Island	4.8	4.6	7.1	7.9	9.0	9.9	11.1	13	2.2	492	
Thule	2.6	2.2	4.7	6.2	8.3	10.9	13.0	20	2.7	970	
Tripoli	3.6	3.4	5.6	6.5	7.2	8.0	8.8	9	2.0	428	
Washington, D.C.	2.5	2.4	4.3	4.8	5.3	5.6	6.9	8	1.6	622	
Wiesbaden	3.0	2.5	6.2	7.4	9.0	10.8	12.4	15	3.1	365	
Zhanna/Semey	1.2	0.5	2.9	3.4	4.9	6.2	7.3	8	1.6	129	

TABLE A9. Cumulative distributions of wind speed (m/s) for September.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	2.9	2.3	5.4	6.7	8.2	9.4	11.0	18	2.7	150	
Albrook	2.6	2.6	4.6	5.1	6.3	7.0	7.4	8	1.8	391	
Albuquerque	4.2	3.4	6.8	8.1	9.2	10.6	12.1	19	2.5	417	
Alert	3.4	2.5	5.8	9.5	12.1	13.1	14.0	15	3.7	150	
Anchorage	3.1	2.8	5.0	5.7	7.6	8.8	9.4	10	2.0	419	
Bahrein	3.6	3.3	6.2	7.3	8.7	9.9	11.2	12	2.6	150	
Barrow	5.7	5.2	8.7	9.4	11.1	12.6	13.5	16	2.7	408	
Barter Island	6.0	5.0	9.4	10.9	12.9	15.1	19.2	31	3.8	417	
Berlin	3.4	3.4	5.4	6.1	7.1	7.9	9.2	10	1.9	150	
Chateauroux	3.5	3.3	5.5	6.6	7.9	9.7	11.2	13	2.4	413	
Churchill	8.5	7.9	13.1	14.8	16.5	18.4	20.1	22	4.3	384	
El Paso	4.4	4.0	7.4	8.4	9.5	10.0	10.5	11	2.5	416	
International Falls	3.8	3.7	5.4	6.2	7.5	8.8	9.3	11	2.0	473	
Kadena	4.7	3.9	7.5	9.3	12.1	14.6	18.1	21	3.5	417	
Kagoshima	4.3	3.6	7.2	8.6	10.5	13.1	18.0	19	3.2	150	
Keflavik	7.1	6.5	11.3	13.0	15.0	17.3	19.4	25	4.2	949	
Kwajalein	4.0	3.9	6.3	7.0	7.9	8.9	9.3	12	2.2	406	
Miami	3.4	3.0	5.1	5.7	7.3	9.3	12.7	21	2.3	436	
Montgomery	1.1	3.0	5.0	5.4	6.8	8.1	9.2	14	1.9	593	

TABLE A9 (Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Moscow	2.3	2.1	4.2	5.0	6.7	9.9	11.1	13	2.4	180	
Munich	3.0	2.6	5.2	6.3	7.4	8.9	10.2	15	2.3	300	
New York	4.9	4.5	7.2	8.4	9.8	11.1	12.4	21	2.5	459	
Norfolk	4.4	3.8	7.2	8.3	9.4	11.1	13.3	19	2.7	534	
Osan-Ni	2.7	2.4	5.3	6.6	8.0	9.7	11.0	13	2.6	712	
Peoria	4.1	3.9	6.1	7.0	8.1	9.0	9.4	11	1.9	548	
San Juan	2.8	2.8	4.9	5.3	6.3	7.1	7.7	9	2.0	361	
Shemya	7.5	7.2	10.8	11.7	13.4	15.2	16.6	21	3.4	274	
Stephenville	4.0	3.5	7.0	8.2	9.5	11.3	13.0	18	3.1	955	
Swan Island	4.9	4.6	7.1	8.2	9.4	10.6	11.2	12	2.2	432	
Tatoosh Island	5.8	5.2	9.2	10.4	11.8	13.6	16.8	20	3.4	478	
Thule	3.1	2.6	5.0	6.1	8.3	10.6	13.0	20	2.7	950	
Tripoli	3.8	3.7	5.9	6.8	7.5	9.0	10.1	11	2.2	18	
Washington, D.C.	2.6	2.5	4.6	5.1	5.5	6.7	7.4	10	1.7	599	
Wiesbaden	3.3	3.0	6.0	7.3	8.9	10.2	11.8	14	2.8	359	
Zhana/Semey	1.3	0.5	3.1	3.9	5.2	6.5	7.3	10	1.8	131	

TABLE A10. Cumulative distributions of wind speed (m/s) for October.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	3.5	2.7	6.5	8.2	10.3	11.5	12.4	13	2.9	155	
Albrook	2.4	2.3	4.5	5.3	6.4	7.2	7.9	10	2.0	424	
Albuquerque	3.8	3.1	6.5	7.9	9.2	10.7	12.1	13	2.5	434	
Aiert	3.5	2.2	6.7	9.9	12.6	15.8	17.1	22	4.2	155	
Anchorage	3.1	2.9	5.2	6.2	7.4	8.8	9.8	19	2.2	432	
Bahrein	3.3	3.1	5.5	6.8	8.1	9.1	10.0	11	2.4	155	
Barrow	6.6	5.9	10.0	11.1	12.6	13.8	14.9	16	3.1	409	
Barter Island	7.2	6.0	11.5	13.5	16.6	19.7	21.5	23	4.5	413	
Berlin	3.7	3.4	5.3	6.0	7.0	7.6	8.0	8	1.7	154	
Chateauroux	3.6	3.2	5.9	6.8	7.8	9.2	10.9	17	2.3	425	
Churchill	8.5	8.0	13.0	14.5	16.8	19.3	21.1	25	4.4	425	
El Paso	4.6	4.2	7.4	8.5	9.9	12.1	13.2	16	2.8	436	
International Falls	4.0	3.9	6.0	7.0	8.2	9.1	9.5	13	2.2	494	
Kadena	5.0	4.6	7.9	8.9	10.0	11.3	12.5	15	2.6	466	
Kagoshima	4.2	3.5	6.7	8.4	11.0	12.3	13.4	14	2.8	155	
Keflavik	7.6	6.2	11.9	13.6	15.8	19.0	21.6	37	4.8	982	
Kwajalein	4.2	4.1	6.4	7.1	8.0	9.3	10.4	11	2.1	394	
Miami	3.5	3.1	5.4	6.6	8.0	9.3	10.5	14	2.1	434	
Montgomery	2.8	2.7	4.5	5.1	5.7	6.8	7.4	10	1.6	553	

TABLE A10 (Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Moscow	3.1	2.7	5.3	6.4	6.5	9.4	10.9	12	2.4	186	
Munich	3.0	2.5	5.3	6.9	9.1	10.8	12.0	13	2.6	310	
New York	5.2	4.7	8.2	9.2	10.5	11.4	13.0	16	2.6	485	
Norfolk	4.9	4.2	8.4	9.3	10.8	12.0	13.3	18	3.0	513	
Osan-Ni	2.5	2.4	4.9	5.8	7.1	8.5	9.4	11	2.3	738	
Peoria	4.3	4.1	6.3	7.0	8.0	9.1	10.2	15	1.9	551	
San Juan	2.4	2.5	4.0	4.6	5.1	5.3	5.5	6	1.5	371	
Shemya	9.8	9.9	14.3	15.2	18.5	20.3	21.1	22	4.5	278	
Stephenville	4.5	4.1	7.5	9.0	10.8	12.7	14.9	22	3.4	983	
Swan Island	4.4	4.3	6.6	7.2	8.3	9.2	10.4	13	2.1	416	
Tatoosh Island	7.3	6.8	11.3	13.1	15.8	18.5	19.5	28	4.2	492	
Thule	3.7	3.1	5.6	7.2	9.0	10.8	12.7	18	2.6	978	
Tripoli	3.8	3.4	6.3	7.3	8.5	9.3	10.5	12	2.3	360	
Washington, D.C.	2.8	2.6	4.9	5.4	6.9	8.2	9.1	13	2.1	559	
Wiesbaden	2.9	2.6	5.5	6.6	7.6	8.8	9.4	13	2.7	369	
Zhanna/Semey	2.4	1.9	4.9	6.0	7.2	9.3	12.1	13	2.6	139	

TABLE A11. Cumulative distributions of wind speed (m/s) for November.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	3.9	3.2	6.6	7.7	9.2	11.9	13.2	15	2.8	150	
Albrook	2.8	2.8	4.7	5.2	5.8	6.9	7.4	8	1.8	399	
Albuquerque	3.5	2.9	5.8	7.2	8.7	9.9	11.5	18	2.4	417	
Alert	3.2	2.4	5.3	8.8	10.9	13.1	16.5	18	3.6	150	
Anchorage	3.0	2.9	5.0	5.4	6.8	8.3	9.3	10	2.0	415	
Bahrein	4.3	4.1	7.4	8.5	9.4	10.7	11.3	12	2.8	150	
Barrow	6.2	5.4	9.5	11.1	12.8	14.2	15.3	20	3.2	413	
Barter Island	6.5	5.3	11.0	12.9	14.5	15.2	16.4	21	4.0	413	
Berlin	3.7	3.5	5.8	6.6	7.4	8.6	9.0	9	1.9	150	
Chateauroux	4.4	3.8	7.3	8.7	10.6	13.5	14.8	16	3.0	355	
Churchill	8.7	8.0	13.4	15.0	17.7	19.8	21.5	23	4.6	398	
El Paso	4.3	3.6	7.1	8.3	9.7	11.4	13.1	18	2.8	418	
International Falls	4.3	4.1	6.5	7.5	8.8	9.8	11.6	13	2.3	482	
Kadena	5.1	4.9	8.2	8.9	9.5	10.8	11.5	18	2.7	443	
Kagoshima	3.9	3.3	6.3	7.2	8.9	9.7	10.4	11	2.3	150	
Keflavik	7.8	7.2	12.7	14.5	16.8	19.7	21.7	30	4.8	822	
Kwajalein	6.4	6.1	9.8	10.8	11.9	12.9	13.4	19	3.0	301	
Miami	3.6	3.2	5.4	6.6	7.9	8.9	9.4	11	1.9	419	
Montgomery	3.2	3.0	5.2	6.1	7.2	8.4	9.4	13	1.9	542	

TABLE A11 (Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Moscow	3.3	3.0	5.1	5.5	7.0	10.2	11.2	12	2.3	180	
Munich	2.8	2.4	4.7	5.4	7.2	9.6	11.1	14	2.2	300	
New York	5.6	5.1	8.7	9.7	11.1	12.3	13.3	14	2.7	462	
Norfolk	5.0	4.7	8.0	8.7	9.4	11.7	13.3	21	2.7	484	
Osan-Ni	2.6	2.3	5.1	6.2	7.6	9.2	10.5	14	2.6	716	
Peoria	5.1	4.8	7.8	8.7	9.4	10.8	11.7	13	2.4	543	
San Juan	2.9	2.8	4.8	5.2	6.1	7.0	7.4	10	1.8	357	
Shemya	9.6	9.1	13.9	15.4	18.5	19.9	21.3	24	4.5	258	
Stephenville	5.1	4.5	8.4	10.0	12.0	15.4	17.7	25	3.8	936	
Swan Island	5.3	4.9	7.3	8.2	9.1	10.0	10.9	12	1.8	413	
Tatoosh Island	8.4	8.2	12.7	13.7	15.4	17.8	19.7	25	4.2	474	
Thule	3.0	2.6	4.9	5.7	7.6	9.8	12.0	20	2.4	928	
Tripoli	3.9	3.2	6.2	7.2	8.8	11.0	14.8	20	2.7	407	
Washington, D.C.	3.5	3.2	5.5	7.0	8.5	9.5	12.3	16	2.5	541	
Wiesbaden	3.4	3.1	6.2	7.3	8.6	9.3	11.1	18	2.8	358	
Zhana/Semey	2.9	2.3	5.3	6.9	9.4	11.6	13.2	14	3.0	125	

TABLE A12. Cumulative distributions of wind speed (m/s) for December.

STATION	MEAN	PROBABILITY THRESHOLDS (%)							MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00				
Akita	5.3	4.5	9.3	10.6	12.3	14.0	16.0	17	3.7	155	
Albrook	3.8	3.5	5.4	6.3	7.3	8.5	9.2	10	1.8	427	
Albuquerque	3.4	2.9	5.2	6.5	8.4	9.5	11.1	18	2.3	435	
Alert	2.9	1.7	5.3	8.3	11.0	15.2	20.0	21	4.0	154	
Anchorage	2.6	2.5	4.6	5.3	6.5	7.4	8.8	11	1.9	434	
Bahrein	4.9	4.7	8.5	9.1	9.9	11.1	12.0	13	3.1	155	
Barrow	5.2	4.4	8.7	9.9	12.0	13.3	14.8	17	3.3	422	
Barter Island	7.1	6.1	11.4	13.3	15.2	18.9	20.7	22	4.4	412	
Berlin	4.3	4.2	6.6	7.3	8.3	9.0	9.4	13	2.0	153	
Chateauroux	4.9	4.4	7.4	8.9	10.9	12.8	14.2	16	2.9	427	
Churchill	8.2	7.9	12.4	13.7	15.2	16.6	17.5	21	3.8	409	
El Paso	4.3	3.8	6.6	7.7	9.7	11.5	13.1	16	2.6	431	
International Falls	4.0	3.9	5.5	7.1	8.6	9.5	11.0	13	2.3	496	
Kadena	4.9	4.4	7.7	8.6	9.4	10.8	11.6	13	2.5	465	
Kagoshima	3.9	3.3	6.6	7.6	8.8	9.4	11.0	14	2.5	155	
Keflavik	8.1	6.9	13.3	15.3	18.2	20.3	22.4	28	5.1	849	
Kwajalein	8.8	8.9	11.1	11.4	12.4	13.1	13.4	19	2.1	296	
Miami	3.6	3.3	5.4	6.4	7.3	8.5	9.1	10	1.8	432	
Montgomery	3.3	3.1	5.3	6.1	7.2	8.5	9.7	14	2.0	540	

TABLE A12 (Continued)

STATION	MEAN	PROBABILITY THRESHOLDS (%)						MAXIMUM OBSERVED	STANDARD DEVIATION	NUMBER OF OBSERVATIONS
		50.00	84.10	90.00	95.00	97.72	99.00			
Moscow	3.3	3.0	5.0	5.4	6.7	9.0	10.9	14	2.2	186
Munich	3.4	2.8	5.4	6.8	8.9	11.2	13.0	16	2.6	309
New York	5.7	5.0	9.0	10.2	11.6	13.2	15.1	22	3.1	495
Norfolk	5.0	4.6	8.0	8.9	9.8	11.3	12.7	17	2.6	493
Osan-Ni	2.6	2.4	5.2	6.4	7.7	9.4	11.1	16	2.6	739
Peoria	4.7	4.5	6.9	7.5	8.5	9.0	9.5	10	1.9	545
San Juan	3.4	3.0	6.0	6.8	7.5	8.6	9.2	11	2.3	358
Shemya	9.9	9.9	14.2	15.3	17.7	19.7	21.1	26	4.4	288
Stephenville	6.0	5.4	9.9	11.3	13.4	17.3	19.6	27	4.3	983
Swan Island	5.8	5.2	8.4	9.0	9.5	10.8	11.4	13	2.2	422
Tatoosh Island	9.2	8.6	14.5	15.9	18.2	19.9	21.3	25	4.8	494
Thule	2.7	2.5	4.5	5.2	6.9	9.1	11.0	13	2.2	948
Tripoli	4.7	4.1	7.5	9.0	10.7	12.6	14.6	20	3.0	425
Washington, D.C.	3.5	3.1	5.7	7.2	8.7	9.7	11.0	12	2.5	558
Wiesbaden	5.6	3.2	6.7	7.8	9.2	11.1	13.2	15	3.1	366
Zhana/Semey	3.3	2.6	6.4	7.3	10.1	11.8	12.2	12	3.1	123

TABLE A13. Elevation, location, and period of record for stations included in Tables 1-12.

STATION	ELEVATION (m)	LATITUDE	LONGITUDE	PERIOD OF RECORD
Akita	10	39°43'N	140°06'E	Jan 56-Dec 60
Albrook	6	8°59'N	79°34'W	Jan 55-Jul 63
Albuquerque	1619	35°03'N	106°37'W	Jan 56-Jun 63
Alert	66	82°30'N	62°20'W	Jan 56-Dec 60
Anchorage	30	61°10'N	149°59'W	Jan 56-Apr 63
Bahrein	2	26°16'N	50°37'E	Jan 56-Dec 60
Barrow	8	71°18'N	156°47'W	Jan 56-Apr 63
Barter Island	15	70°08'N	143°38'W	Jan 56-Dec 63
Berlin	48	52°29'N	13°24'E	Jan 56-Dec 60
Chateauroux	162	46°51'N	1°43'E	Jul 57-May 64
Churchill	30	58°57'N	94°11'W	Jan 56-Apr 63
El Paso	1195	31°48'N	106°24'W	Jan 56-May 63
International Falls	360	48°34'N	93°23'W	Jan 56-May 64
Kadena	49	26°21'N	127°45'E	Jan 56-Jun 63
Kagoshima	5	31°34'N	130°33'E	Jan 56-Dec 60
Keflavik	49	63°57'N	22°37'W	Jan 56-Oct 63
Kwajalein	11	8°44'N	167°43'E	Jan 56-Dec 62
Miami	4	25°49'N	80°17'W	Jan 56-Jul 63
Montgomery	61	32°18'N	86°24'W	Jun 56-May 64
Moscow	186	55°45'N	37°34'E	Jul 55-Jun 61
Munich	526	48°08'N	11°42'E	Jan 56-Dec 60
New York	5	40°40'N	73°47'W	Sep 56-Dec 62
Norfolk	9	36°53'N	76°12'W	Jan 56-Dec 62
Osan-Ni	15	37°06'N	127°02'E	Apr 57-Apr 63
Peoria	201	40°40'N	89°41'W	Sep 56-May 64
San Juan	19	18°27'N	66°06'W	Jan 56-Apr 63
Shemya	34	52°43'N	174°06'E	Jul 58-Jul 63
Stephenville	58	48°32'N	58°33'W	Jan 56-Feb 64
Swan Island	10	17°24'N	83°56'W	Jan 56-Jul 63
Tatoosh Island	31	48°23'N	124°44'W	Jan 56-May 64
Thule	39	76°33'N	68°49'W	Jan 56-Feb 64
Tripoli	11	32°54'N	13°17'E	Jan 56-Dec 62
Washington, D.C.	88	38°50'N	76°57'W	Jan 56-May 64
Wiesbaden	134	50°00'N	8°20'E	Jan 51-Dec 57
Zhana/Semey	206	50°21'N	80°15'E	Nov 58-Oct 63

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